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JRC 96

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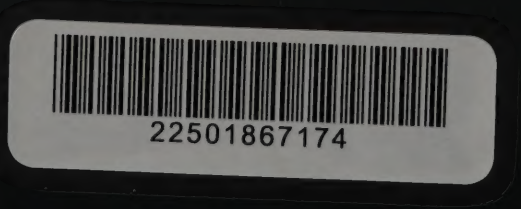
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"What are my ambitions for the Joint Research Centre? To ensure that its scientific excellence serves the needs, the expectations and the hopes of Europe's peoples."

Edith Cresson

JOINT RESEARCH CENTRE
EUROPEAN COMMISSION



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Foreword

1996 has been a successful year in the evolution of the JRC towards more customer driven research and competitivity within the framework of the technical objectives defined by the Council decisions for the period 1995-1998.

While keeping its character of an organisation which is at the service of the Commission, and devoting a considerable part of its effort to research linked to the activities of European Institutions, the JRC is also sensitive to the needs of the market. Work performed on a contractual basis for outside third parties forms a growing part of its activities. The Centre has research installations which are too expensive or specialised to be multiplied in Europe, and which can thus only be set up at the European level. These installations are used in its own programmes and also made available for other public or private organisations through collaboration agreements or contractual arrangements.

JRC activities have the effect of creating links between teams in Member States situated at different levels of scientific and technological development. They thus help to bring the Member States close together. At the initiative of Commissioner Madame Edith Cresson, the JRC has initiated a new approach to the marketing, valorisation and commercialisation. As part of the drive to improve collaborative research and technology transfer to industry the Commission also decided to launch a feasibility study on creating a European Technology Park in Ispra in order to make a fuller use of the competence and installations of the JRC there.

During the year the Centre has been evaluated by outside experts participating in Visiting Groups for each one of the JRC Institutes. The overall evaluation by Prof. Rojo testified to further progress in performance.

The year was marked also by the Commission decision to give the JRC the status of an autonomous Directorate-General. The objective is to facilitate the transition to new working methods, better use of competences and installations and new ways of commercialisation.

In the discussions on the Fifth Framework Programme, the JRC contributed its views to the policy documents issued by the Commission. The Centre will constitute one of the essential mechanisms for the programme's implementation.

The JRC has capitalised on its multi-disciplinarity, its role as a neutral organisation forming part of the services of the European Commission and the many collaborations it has developed with research organisations in the Member States and third countries.

The activities of the JRC will continue to be oriented towards its users and their requirements. The JRC continued its participation in a large spectrum of competitive activities: shared cost actions with partners from Member States; Scientific and Technical support to the Commission services and third party work for external customers. Overall results during the year are promising. Dissemination of information has been also intensified in an effort to establish closer collaboration with industry, research centres and universities in the Member States.

J.-P. Contzen
Director-General



Observations by

1996 A YEAR OF SUCCESSFUL CHALLENGE FOR THE JRC

1996 was a year of successful challenge for the JRC, due to its efforts to comply with the demands for more customer driven research and competitivity while maintaining its Community character. These demands were put to the Centre by the Community Institutions back in 1994, with implementation to be initiated in 1995. A first progress report was requested by the Council and issued by the Commission in 1996, covering the first one and a half years of the new programme period. The Board assisted the JRC in its preparation and accompanied the report with an opinion. This opinion recorded satisfaction with progress made to sustain the initiatives taken, while commenting also on room for further improvement. The Board has been pleased to learn of the endorsement this report has received from the Council and the European Parliament.

The *Annual Report* 1996 bears witness to these sustained developments. Highlighted activities from the large JRC portfolio of ongoing projects amply illustrate how the Centre is contributing to the Union's objectives, including the sustainable growth in the Member States and its service to the European citizen. The numerous network arrangements aim at ensuring the interaction between the JRC's activities and those of industry, national research laboratories and universities.

The full spectrum of competitive activities opened up for the JRC in 1995 was a new challenge and called for a reorientation of the Centre's modes of operation. The results of the first year were encouraging. The 1996 *Annual Report* records the progress made and illustrates that all seven institutes of the JRC have engaged themselves in every facet of the new opportunities laid out for the JRC. The challenge for the JRC–as for all knowledge producers in the Community–is how to accelerate the rate of exploiting the knowledge resource for the benefit of European industry and citizens–how to improve their economic position and well-being. The record shows that the JRC has responded positively to this challenge. As one of the key European S&T players it recognises the responsibility placed upon it and will continue to respond positively to the trust placed in it by Member States in the 1994 Council Conclusions.

EVALUATIONS OF THE JRC

1996 again saw an evaluation of the JRC activities performed by outside experts in conformity with the Council decisions on the JRC specific programmes and carried out upon consultation with the Board. Visiting Groups were selected for each of the JRC institutes and Professor J.M. Rojo, former Secretary of State for Research in Spain, provided an overall evaluation and analysis of the reports from the Visiting Groups which was discussed with the Board in December 1996.

The findings of these reports largely confirm satisfactory further progress which has taken place in the JRC since the previous evaluations in 1993-1994. The many detailed recommendations will provide a stimulus for the way forward. Amongst the more critical remarks the Board agrees that there is still room for improvement in the operation of the Centre and notably in the boundary conditions which govern–and limit–its activities.

EVOLUTION OF JRC STATUS

As foreseen, in 1996 the Commission decided to give the JRC the status of an autonomous Directorate General–a welcome step, which in the repeatedly stated view of the Board should be followed by further moves to allow the JRC to fully achieve the change in working methods envisaged by the Council Conclusions of April 1994 and, indeed, in order to wholly fulfil its mission. To facilitate this , the possibility of endowing the JRC with legal personality has been considered.

COMMERCIALISATION OF THE JRC DISSEMINATION OF INFORMATION

1996 called for new initiatives on the commercialisation of JRC activities and research results. A closer attention to goals and performance parameters has raised the awareness of these essential issues within the JRC institutes and has borne fruit, as evidenced by the 1996 *Annual Report*. The Board welcomes the fact that new imaginative initiatives are under way, including pooling of commercial contracts and increasing awareness of the intellectual property. Amongst those the Board has agreed to the initiation of a feasibility study to be launched in early 1997 on creating a Technology Park at the JRC Ispra site.

Meanwhile, the JRC has intensified the dissemination of information on its activities at national level. As a contribution to this, in 1996 Members of the Board together with the JRC, again arranged for a series of presentations of the JRC throughout the Member States, gathering representatives from industry, national research and universities together with JRC representatives in order to foster further collaboration with the Centre.

HIGH FLUX REACTOR

1996 brought a Council decision on a supplementary programme for the High Flux Reactor (HFR) at Petten (NL) for the period 1996-1999. This implied a complete overhaul of the management of the facility and an intensive drive towards a more direct commercial use of a considerable part of its capacity with the ensuing improvement in efficiency and economy, as already planned in 1995. Preliminary results give the basis for optimism.

TOWARDS THE FIFTH FRAMEWORK PROGRAMME

The Board has noted with keen interest the policy documents issued by the Commission in 1996 towards the Fifth Framework Programme for Research and Technological Development which should begin in 1999 and the views on the JRC contained in these documents. It has also noted discussions on these documents which have already taken place. Further discussions on this will no doubt follow in early 1997. The JRC may be called to face new challenges, but the Board is convinced that full benefit will be drawn from the contribution of the JRC to the major objectives of the European Union. This will comprise not only its ability to act as a European wide resource to build efforts around infrastructural critical mass but also its ability to improve neutral and independent expertise at the European level.

STAFF ISSUES

The evaluation reports have underlined the need for changes in present procedures concerning staff management and notably for recruitment. These views are fully shared by the Board. The problem will become even more acute in the near future as the age structure of JRC staff will result in many vacancies, whose timely filling is of paramount importance for the future of the JRC. Stimulated by the evaluation reports, the Board intends once again to address the issues concerning the staff policy and its implementation at the JRC.

At senior level, the Board has welcomed the appointment of Mr Hugh Richardson to the new post of Deputy Director-General in 1996 and noted the progress of the four new Directors appointed in 1995. It has also advised the Commission on the appointment of Professor Grasserbauer, who takes up his post as Director of IRMM in early 1997. Mr H. Allgeier, the first Director of IPTS in Seville was transferred by the Commission at the end of the year to another function within the Commission and is thanked for setting this Institute well under way.

The Board congratulates Mr Hans Jørgen Helms, formerly Director of Programmes, who retired in 1996 and who was nominated to the rank of Honorary Director-General in recognition of his dedication and continuous service to the Joint Research Centre.

ACKNOWLEDGEMENTS

The Board acknowledges Commissioner Cresson's continued interest in the JRC, as evidenced by the reports from her visits to the JRC sites during the year. The Board reiterates its appreciation of the hard work and devotion of the Director-General, his senior collaborators, and indeed the entire JRC staff in addressing the challenges facing them.



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Highlights

The JRC scientific and technical work is mostly interdisciplinary and covers a large number of projects.

The following few examples illustrate differing areas of activity and varied funding arrangements for the JRC work in 1996.

The MARS project (Monitoring Agriculture with Remote Sensing) carried out by the JRC's Space Applications Institute (SAI) provides constantly updated agrometeorological information enabling accurate monitoring and extrapolation of crop development in Europe and beyond. The approach is based on an agrometeorological model drawing on weather data (rainfall, temperature, radiation evaporation...) and agronomic data (growth state, water content, biomass produced, grain weight, etc.). The advantage of the system is that it provides homogeneous information in real time covering a wide geographical area. It is also useful as an early warning system (e.g. identification of abnormalities in crop patterns of development).



Color composite image derived from NOAA/AVHRR channel 1 and 2 data (year 1991). Red = annual minimum red reflectance. Green = annual maximum Near Infrared reflectance. Blue = annual Near Infrared reflectance standard deviation. This compositing is a first step toward the obtaining of a European land cover image.

In September 1996 the Council of the EU adopted the Directive on **Integrated Pollution Prevention and Control (IPCC)** which marks a new era in environmental legislation. In contrast to the traditional approach of setting emission standards of general applicability, the IPPC directive integrates the different pollution media (e.g. air and water or land) and takes into account both the sensitivity of the local environment and the technological progress. It covers large installations of the most polluting industrial sectors such as the chemical, metal and energy industries. The Best Available Techniques (BAT) in these sectors will be identified by the **'IPPC Bureau'** through a process involving representatives from the fifteen Member States of the Union and the relevant industrial and environmental organisations. These BAT documents will constitute the main reference once issuing local permits. The IPPC Bureau is established at the JRC Institute for Prospective Technological Studies (IPTS) which holds responsibility for technology watch at European level. IPTS has acquired significant expertise on BAT studies (an analysis of the sectors of ammonia and nitric acid has just been completed) and has won the contract to manage the IPPC Bureau. IPTS will promote the exchange of information and ensure neutrality in the process of finding consensus among all the concerned parties.

BIOMEDICAL REFERENCE MATERIALS

Biomedical Reference Materials, which are needed for the development and verification of the accuracy and correctness of diagnostic test kits (e.g. pregnancy, hepatitis, diabetes, certain cancers), are now certified by the JRC (Institute for Reference Materials and Measurements (IRMM)).

An agreement with the International Federation of Clinical Chemistry (IFCC), signed in October 1996 by Commissioner Edith Cresson, provides for reference materials produced on the basis of projects proposed by the IFCC to be tested and certified by the Institute. Revenues from sales of the resulting materials are shared by IFCC and the Institute.

The Eurocodes are design standards adopted by the European construction industry. **Eurocode 8** specifies standards that buildings should adhere to if they are to withstand vibration, whether caused by road or rail traffic or even by earthquakes. The standards are checked by a consortium of European laboratories using a variety of methods including computational analysis and shaking tables. The JRC (Institute for Systems, Informatics and Safety (ISIS)) is part of this consortium; its main contribution is the development and operation of the reaction wall facility (unique in Europe) (**European Laboratory for Structural Assessment (ELSA)**) which utilises the pseudodynamic test method to test full-scale structures. The validity of Eurocode 8 has been confirmed for bare frame reinforced concrete structures thanks to the testing of 3-storey concrete frames in the facility. In addition, the code has been modified to take into account infilling of the building frames with non-structural materials.

ELSA is also used to check methods for retrofitting in order to protect existing buildings, particularly those of great historic interest, from damage due to vibration.



Earthquake behaviour of a historic monument investigated at the European Laboratory for Structural Assessment

Collaborative research on a commercial basis is carried out by the JRC (Institute for Advanced Materials (IAM)) in the area of materials requirements for improved design and operation of high temperature components for power generation plants. Evaluating the work carried out, Professor Regis of ENEL (the Italian electricity utility–the customer) recently wrote:

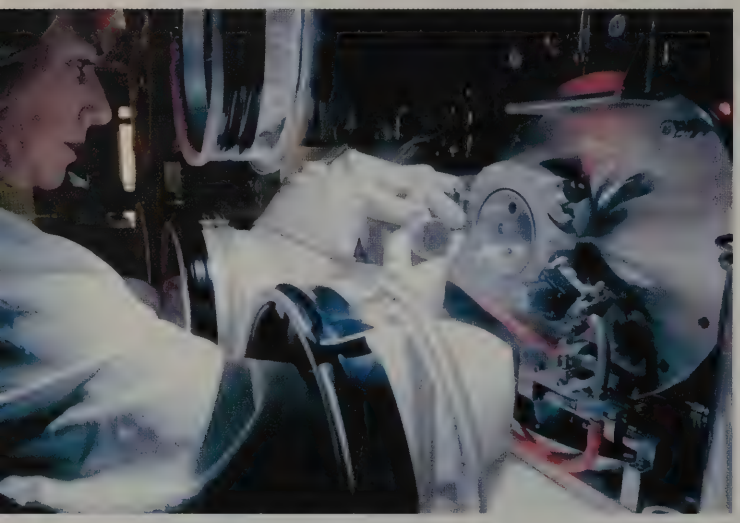
"All the individual subprojects have carried out excellent experimental investigations, according to the state of the art, some of which have been anticipated in specific papers. The findings are generally in good agreement with the most advanced conclusions reached by large manufacturers or with the practices under testing by other utilities. These results are highly valuable since they would allow extended scientific exchanges of information and know-how with other international laboratories, with other end users, with the Original Equipments Manufacturers (OEM) and their subsidiary companies in charge of material and coating processing".

The European Agency for the Evaluation of Medicinal Products (EMEA), set up at Canary Wharf, London, in 1995, relies for its drug approval and registration activities on the expertise of the JRC. The **European Technical Office for Medicinal Products (ETOMEP)** (a branch of the JRC's Environment Institute) develops and supports the technical systems needed for the market authorisation procedures and maintains staff in the EMEA's premises. The help and support provided by the JRC have been widely acknowledged by the Agency itself and the Member States.

VAGABONDING FISSILE MATERIALS

In cooperation with the Commission's Safeguards Directorate, Luxembourg, and following Member States' requests, the JRC (Institute for Transuranium Elements (ITU)) has analysed further confiscated fissile materials.

The diversity and the high accuracy of the analyses enable a 'fingerprint' of the seized material to be obtained. This enables the previous history of the material to be understood and provides clues as to its origin with the aid of a data bank.



Analysis of vagabonding fissile materials

The role of the JRC in this field, already recognised at the Essen Summit, has led to several projects in the frame of the TACIS (Technical Assistance to the CIS Countries) and PHARE programmes (PHARE is the EU programme to assist Poland, Hungary, Armenia, Bulgaria, Slovenia, Albania, Estonia, Latvia and Lithuania). ITU staff also frequently appear as expert witnesses in the courts or parliamentary inquiry committees of Member States concerning so-called vagabonding nuclear materials. The Institute is actively involved in the work of the P-8 International Technical Working Group on Illicit Trafficking of Nuclear Materials.

COMPETITIVE ACTIVITIES, MARKETING

In 1996, the JRC won a number of important research contracts, such as the substantial PHARE contract on agricultural information systems, including satellite based applications of remote sensing for six PHARE countries.

Work for outside third parties progressed and new customers were found to take advantage of JRC scientific competence and experimental installations, some of which are unique in Europe.

At the initiative of Commissioner Edith Cresson, a new approach to the marketing, valorisation and commercialisation of the JRC was initiated; the Commission decided to launch a feasibility study on creating a European Technology Park at the largest JRC site, Ispra, in northern Italy. The objectives are: to make fuller use of the competence and installations of the JRC, create synergy between the JRC, industry and other research centres, promote the creation of innovative firms, in particular SMEs, and encourage innovation in existing companies.

Particular measures include increased attention to quality management. The first certification, by an accredited outside body of the implementation of quality standards, was made during the year. Clear definition of performance indicators to be used by management at all levels was given, while new steps were taken to extend industry and other user involvement through User Advisory Groups for the JRC Institutes. Marketing efforts have been focused with the aid of clearly defined marketing plans for the JRC as a whole and each Institute.



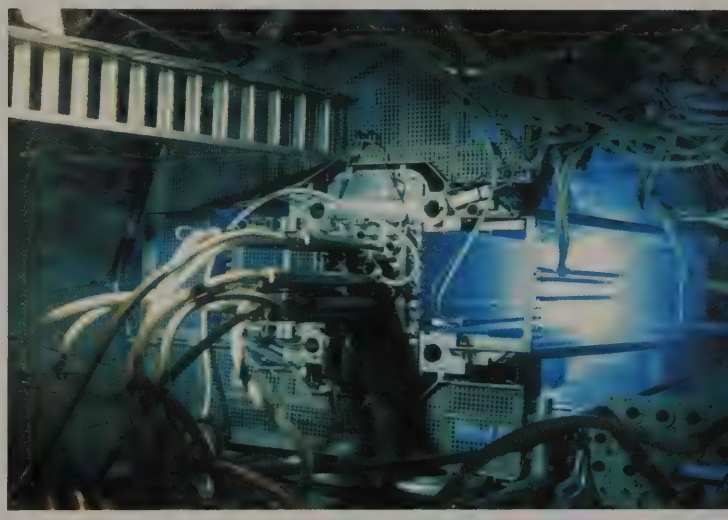
ORGANISATIONAL MEASURES STAFF POLICY

The 1995-1998 guidelines for the JRC called for flexible and dynamic operation of the Centre and underlined the need to ensure a gradual transition and an adaptation of existing rules and regulations. The Commission decided to establish the JRC as an autonomous Directorate-General in January, 1996 and reorganised the Ispra site by merging two of its institutes, IST and ISEI, into the Institute for Systems, Informatics and Safety (ISIS), thereby strengthening JRC research on technological risk evaluation and safety issues.

1996 saw the implementation of the Commission's policy for all Commission research staff. The concept of a 25% contingent of short term staff has already added flexibility and enabled the constant renewal of scientific competence.

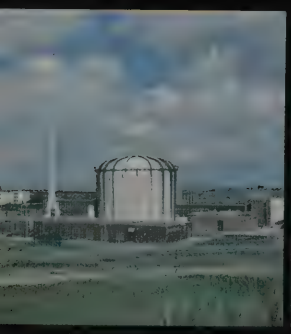
HIGH FLUX REACTOR AT PETTEN

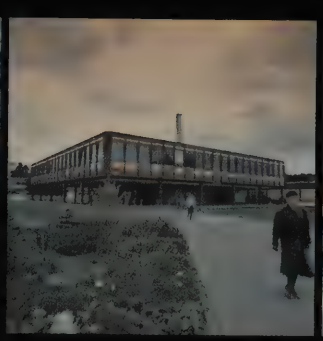
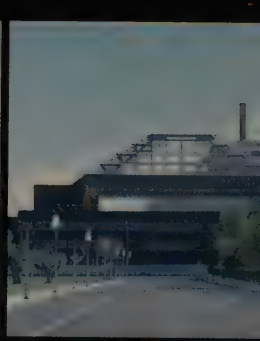
In June 1996, the Council approved a new supplementary EURATOM programme for the High Flux Reactor (HFR) at Petten (NL), covering the period 1996-1999. The new programme, in which Germany, France and the Netherlands take part, has involved a complete overhaul of the management of the facility and an intensive drive towards a more direct commercial use of a considerable part of its capacity, involving the production of radio-isotopes for medical use. In 1996 an estimated 7 million patients were diagnosed or treated using radio-isotopes produced at Petten.



Top view of core and side pool facility at High Flux Reactor Unit

Petten Geel Ispra Karlsruhe Seville





The Joint Research Centre in 1996

PART 1

The Joint Research Centre

The Joint Research Centre exists to serve the European Union. Its mission is to provide the European Union with a scientific and technical capability, directly attached to the Commission, contributing to the formulation and implementation of Union policies. The JRC is the "corporate research laboratory" of the European Commission. It is established by the European Commission with headquarters in Brussels. Five separate sites, located in Belgium, Germany, Italy, the Netherlands and Spain, house seven different institutes, each with its own focus of expertise.

These institutes are:

IRMM	The Institute for Reference Materials and Measurements	*Geel* (B)
ITU	The Institute for Transuranium Elements	*Karlsruhe* (D)
IAM	The Institute for Advanced Materials	*Petten* (NL) and *Ispra* (I)
ISIS	The Institute for Systems, Informatics and Safety	*Ispra* (I)
EI	The Environment Institute	*Ispra* (I)
SAI	The Space Applications Institute	*Ispra* (I)
IPTS	The Institute for Prospective Technological Studies	*Seville* (E)

and through them the JRC promotes and carries out customer-driven research of the highest quality and integrity in support of Community policies.

The Joint Research Centre is an integral part of the Community research and technological development system and, increasingly, a driving force in European R&D in favour of both industry and consumers. It has developed over the years special skills, unique tools, and a reliable, neutral scientific expertise adapted to its triple mission: carrying out the specific Community research programmes, decided upon by the Council and funded by the European Union budget; providing customer-driven research as scientific and technical support for other community policies, such as the environment, agriculture or nuclear safety; and engaging itself ever more successfully in competitive activities, i.e. participating on a par with industry, research organisations and universities of the Member States or associated countries in Community programmes, including shared-cost actions under the Framework Programmes, or providing paid services to private and public customers.

The statutory staff, comprising officials and temporary agents of the JRC, was 1 746 at the end of 1996. To this number one must add 186 scientists who were active in the Centre and were paid by the JRC under various hosting schemes. A further 200 scientists and trainees worked at the JRC under other arrangements.

The global credits committed by the JRC in 1996 were around 273 Mioecu.

This Annual Report is intended to give a general overview of JRC activities in 1996.

Readers may find more details in the Annual Reports of the seven institutes. The JRC also publishes numerous scientific reports, presents papers to conferences and in scientific journals, and organises workshops, seminars and conferences to disseminate its scientific output.

The Joint Research Centre in 1996

Contributions to Science and Technology Advancement, European Industry and the Well-being of the European Population

The JRC research activities contribute to several lines of the Community Framework Programmes through the JRC specific programmes 1995-1998:

- The *Industrial Technologies and Materials Technologies* programme was carried out by the Institute for Advanced Materials (IAM) and encompassed research projects on advanced materials, on surface engineering, on new ecofriendly materials and on non-destructive evaluation techniques for the inspection of industrial structural components.

- The *Measurements and Testing* programme encompassed research projects on reference measurements and materials, carried out by the Institute for Reference Materials and Measurements (IRMM), and on the assessment of the reliability of structures, carried out by the Institute for Systems, Informatics and Safety (ISIS).

- The *Environment and Climate* programme consisted of: research projects on atmosphere, soil, water and waste pollution, executed by the Environment Institute (EI); the setting up of the Centre for Earth Observation (CEO), a decentralised European data management and information system; applications of remote sensing techniques, carried out by the Space Applications Institute (SAI); and industrial hazards studies carried out by the Institute for Systems, Informatics and Safety (ISIS).

- The *Non-Nuclear Energy* programme consisted of research projects related to materials for clean technologies and to the standardisation of photovoltaic devices, carried out by the Institute for Advanced Materials (IAM).

- The *Targeted Socio-Economic Research* programme included the Science and Technology Observatory function and prospective work carried out by the Institute for Prospective Technological Studies (IPTS). The essential role of the Institute is to harvest the available contributions from experts, consultants, research organisations and institutes in Member States, and when possible in third countries, in order to analyse, process and integrate them impartially and in depth and, more importantly, to distil clear trends or needs for action in a usable form for decision makers.

- The *Nuclear Fission Safety* programme encompassed a number of research activities ranging from studies on reactor safety, carried out by the Institute for Systems, Informatics and Safety (ISIS) and the Institute for Advanced Materials (IAM), to research activities on nuclear safeguards and fissile materials management, executed by the Institute for Systems, Informatics and Safety (ISIS) and the Institute for Transuranium Elements (ITU). ITU carried out research on the safety of nuclear fuels and actinides.

- The *Controlled Thermonuclear Fusion* programme (Technology and Safety) was carried out by the Institute for Systems, Informatics and Safety (ISIS) and the Institute for Advanced Materials (IAM).

This research is executed in the seven JRC Institutes as shown in *Table 1* (p. 16) and it amounted to 68% of the JRC programme activities in 1996.

Part 2 of this document provides a more detailed description of these research activities in 1996, institute by institute. However, some significant results have been highlighted in this chapter: they illustrate how research has enabled the JRC to contribute to the advancement of science and technology for the benefit of European industry and the well-being of the European population.

A new co-operation agreement signed by Commissioner Edith Cresson, between the **Institute for Reference Materials and Measurements (IRMM)** and the International Federation of Clinical Chemistry (IFCC) will enable the IRMM to push forward its work on good quality health care, by developing biomedical certified reference materials (CRMs). These are increasingly important instruments for the promotion of human health: they increase the reliability and accuracy of diagnosis in the laboratory, thus significantly reducing the risk of diagnostic errors, and they improve the quality of patient treatment.

Table 1

JRC Research Activities

Framework Programme Lines	IRMM	ITU	IAM	ISIS	EI	SAI	IPTS
Industrial Technologies and Materials Technologies							
Advanced Materials and Standards for Industrial Innovation			●				
Surface Engineering for Improved Properties and for New Industrial Applications			●				
Recycling and Materials Eco-Technology			●				
Non-Destructive Evaluation, Testing and Inspection of Industrial Structural Components			●				
Measurements and Testing							
Prenormative Research in Support of Construction Norms and Standards, including Seismic Design Codes (Eurocodes)				○			
Car Safety				○			
Reference Materials	○						
Reference Measurements	○						
Environment and Climate							
• *Global Change*							
Centre for Earth Observation (CEO)						●	
Atmospheric Processes over European Regions					●		
Remote Sensing for Terrestrial Biosphere (Land Degradation in the Mediterranean Region, Forest Monitoring)						●	
Remote Sensing for Marine Biosphere (North Atlantic Ocean, Mediterranean Sea)						●	
Advanced Earth Observation Techniques (Environment and Road Conditions Monitoring and Land Mine Detection)						●	
• *Environmental Quality*							
Techniques and Equipment for Environmental Quality Monitoring					●		
• *Innovative Environmental Technologies*							
Industrial Reliability (Experimental Activities)				●			
High Performance Information Technologies for Environmental Protection				●			
Natural Hazards / Seismic Research				●			
Natural Hazards / Flooding, Droughts						●	
Non-Nuclear Energy							
Photovoltaic Energy and Electricity Storage			○				
Materials for Clean Technologies			○				
Targeted Socio-Economic Research							
Technology Watch / Technology-Employment-Competitiveness							○
Nuclear Safety and Safeguards							
• *Reactor Safety*							
European Networks on Component Ageing, Inspect. Techn. and Struct. Integrity			●				
Severe Accidents including Probabilistic Studies				●			
• *Fuel Cycle Safety*							
Basic Actinide Research		●					
Safety of Nuclear Fuels		●					
Mitigation of Long-lived Actinides and Fission Products		●					
Spent Fuel Characterisation in View of Long-Term Storage		●					
• *Safeguards and Fissile Materials Management*							
Safeguards R&D		●		●			
Controlled Thermonuclear Fusion							
Fluid Separation and Structural Analysis			●				
Fusion Materials			●				
Remote Handling				●			
Tritium-Materials Interaction			●				

Under the agreement, laboratories and scientists around the world will be involved in providing reference materials needed by industry and clinical laboratories.

Certified reference materials of foodstuffs are also prepared at IRMM for food quality control, to assist enforcement of European legislation on food.

The **Institute for Transuranium Elements (ITU)** is intent on further reducing radiotoxicity in highly active wastes through collaborative work carried out with leading national laboratories in the area of mitigation of long-lived actinides and fission products.

Fabrication and characterisation of fuel targets for irradiation experiments and post-irradiation examination to compare the results with theoretical predictions was another major task of ITU. New extraction processes for the effective separation of long-lived actinides were also tested under realistic conditions.

The ITU's contribution to the study of medical applications of actinide research (treatment techniques for different cancers) was enhanced. Several batches of ^{225}Actinium-^{213}Bismuth produced by ITU using new processes were delivered to the Memorial Sloan Kettering Cancer Centre in New York for use in experimental treatments on patients.

The **Institute for Advanced Materials (IAM)** developed three novel activities in 1996 of potential benefit to *European industry*:

The concept of a new pressure vessel for the petrorefinery industry, designed to avoid hydrogen attack of the vessel walls and to provide increased vessel life, enhanced safety for workers, and decreased wall thickness.

A fibre tow transport system for continuous coating of endless fibres.

A chemical vapour deposition process for 3-dimensional shaped micro-structural coatings.

Benefitting the consumer, a method for monitoring the release of metals in the food processing industry, using a thin layer activation technique developed at Ispra's Cyclotron will be applicable in particular to baby food and in the pharmaceutical industry.

A spin-off from the Cyclotron activities will allow development of new diagnostics and therapeutics techniques using Positron Emission Tomography (PET). A new PET project was launched at Ispra, for a European network hosting research medical staff from all over Europe, which will transfer the techniques to their respective home institutions.

At the **Institute for Systems, Informatics and Safety (ISIS)** several activities focused on *safety for industry and the population*, particularly nuclear safety and the safeguarding of nuclear materials, industrial and transport safety, the seismic protection of buildings and civil engineering works, the preservation of cultural heritage, and architecture.

As for nuclear safety, the FARO and KROTOS facilities at Ispra carried out experiments leading to a better understanding of the progression of severe accidents and to an improvement of codes used to analyse how best to mitigate the consequences.

Progress in car safety was fostered by the design and development of a new precision impact testing method. The use of a new stress wave transducer in the Large Dynamic Testing Facility (LDTF) allows load, displacement and energy flow to be measured in any part of a vehicle body, so that numerical models of vehicles can be calibrated and validated.

The facilities of the European Laboratory for Structural Assessment (ELSA) continued to provide a unique test bed for the application of the pseudodynamic test method for checking the seismic resistance of structures, in particular irregular bridges. The method confirmed that bridges which we would have expected from previous tests to suffer severe damage, remained practically intact. It is expected that the concept of seismic isolation will become more common, both for the construction of new bridges and for the retrofitting of existing structures.

The **Environment Institute (EI)** is directly contributing to a *better quality of life* with its specific research in the area of climate and the environment. Global change studies encompass Biogenic Emission in the Mediterranean Area (BEMA Project) and the role of aerosols in climate regulation.

The BEMA project, particularly focused on tropospheric ozone, aims at understanding the role of the Mediterranean vegetation in atmospheric chemistry and ozone formation.

EI also focuses on the study of natural risks, in particular in aquatic systems, at the request of the Commission and the Member States: the study of "red tides" in the Mediterranean Sea (MITO project), and a variety of water management, water quality and recovery projects (e.g. AMAL, AQUACON, SALMON). An Environment Water Task Force was established in 1996, at the initiative of the Commission, to contribute to a European strategy for sustainable management and rational use of water; its aim is to make European enterprises more competitive in this area and to refocus scientific and technological co-operation on priority projects.

Human health was also the concern of the indoor pollution group, whose unique facility for the monitoring of indoor air quality (INDOORTRON) is being used for exposure studies, measurements of pollutant emission from materials and equipment, and for the testing of air cleaning devices.

The **Space Applications Institute (SAI)** concentrated on applications of remote earth observation, sensing

and detection. SAI's institutional research on environment and climate embraced the terrestrial and marine biospheres, the lithosphere and the atmosphere, resulting in a comprehensive approach to the uses of earth observation.

The study of primary production in the ocean can benefit from satellite derived colour data in identifying bio-geo-chemical processes. Applications based on data from new ocean colour sensors are now being developed for the study of the Mediterranean basin.

Among other activities, a new natural hazards project is aimed at improving existing disaster management practices, specifically in the cases of forest fires, floods and droughts. The contribution to a project on the remote detection of antipersonnel land mines is being continued. The measurement of surface water storage in networks of drainage ditches is being developed.

Together, **SAI and ISIS** continued to provide support for the Centre for Earth Observation (CEO) project whose objective is to promote the use of satellite-based earth observation data.

Contributions to the CEO project focused mainly on its design and implementation phase, with work on all four CEO components: User and Applications Support, Enabling Services, Monitoring, and Co-ordination.

The **Institute for Prospective Technological Studies (IPTS)** pursued its observation of all relevant scientific and technological events and trends in Europe, and its following of technical change in order to get a better understanding of the links between technology, economy, and society.

The European Science and Technology Observatory (ESTO) was officially established in 1996, with the task of collecting and processing information. Responsibility in these Technology Watch activities is shared with other partners at the national level. The main themes are: assessment of CO_2-related technologies; technology transfer and advanced materials; human genome analysis, genetic screening and gene therapy; multimedia information society.

On the Technology, Employment and Competitiveness theme, economic and social sustainability is being studied, with a special focus on competitiveness, employment and the role of innovation in regional development and resources management.

SUPPORT FOR COMMUNITY POLICIES

These activities falling under the Community Framework Programmes are necessary for the formulation and implementation of Community policies and accounted for 32% of the JRC's programme activities in 1996 and were related to the following Framework Programme lines: *Information Technologies*, *Environment and Climate*, *Agriculture and Fisheries*, *Targeted Socio-Economic Research* and *Nuclear Safety and Safeguards* through the JRC specific programmes 1995-1998.

The support activities are customer driven, in fulfillment of impartial and neutral scientific and technical requirements arising from EU directives, decisions of the Commission and the Council, or obligations stemming from the Euratom Treaty. The work executed in the JRC Institutes is illustrated in *Table 2*.

In 1996, the three main lines of JRC support activities were:

1. **JRC Support for the Environmental Policy**, which accounted for 43% of the scientific and technical support budget. It provided DG XI with scientific and technical assistance for the implementation of the legislation on chemical pollutants, atmospheric pollution, water quality, chemical waste, industrial risks, and nuclear safety. This work is part of the 5th EC Action Programme in the field of the environment, and includes:

- The European Reference Laboratory for Air Pollution (ERLAP), which was particularly active in the preparation and implementation of EC Directives on ambient air quality, with emphasis on the urban environment and industrial emissions and the harmonisation of measurements in the EU air quality monitoring networks.

- The European Chemicals Bureau (ECB), which is now handling all the technical and scientific tasks required for the classification and labelling of dangerous substances, the implementation of the notification scheme for new substances, testing methods for chemicals and export/import control of dangerous substances.

- The European Centre for the Validation of Alternative Methods (ECVAM), which was created in 1991 to provide S/T support for the regulatory work of the Commission on various chemicals and products. In particular, it co-ordinates efforts to promote orderly scientific and regulatory acceptance of alternative methods which can reduce, refine, or replace the use of animals in laboratory procedures. Its activities included pre-validation of non-animal test

Table 2

JRC Support Activities

Framework Programme Lines	IRMM	ITU	IAM	ISIS	EI	SAI	IPTS
Information Technologies							
Safety and Reliability of Systems				●			
Software Systems				●			
High Performance Computing and Networks				●			
Environment and Climate							
European Reference Laboratory for Air Pollution(ERLAP)					●		
European Chemical Bureau (ECB)					●		
European Centre for the Validation of Alternative Methods (ECVAM)					●		
Support to the European Environment Agency (EEA)					●	●	
Quality Control of Consumer Products (Consumer Protection)	○				●		
Alpine Observatory					●		
Industrial Reliability: Major Accidents Hazards Bureau							
Biotechnology Safety				○			
Foodstuff Analysis in Support of Industrial Policy					●		
European Technical Office for Medicinal Products (ETOMEP)					●		
Methodologies for UCLAF				○			
Agriculture and Fisheries							
Remote Sensing for Agriculture						●	
Animal Identification				●			
European Office for Wine, Alcohol and Spirit Drinks (BEVABS)					●		
Reference Measurements and Materials for Quality Control of Foodstuffs	●				●		
Targeted Socio-Economic Research							
Prospective Technological Studies						○	
Nuclear Fission Safety							
European Networks on Component Ageing and Inspection Techniques			●				
Euratom Safeguards Support: General				●			
Euratom Safeguards Support: On-Site Laboratories and ECSAM	●	●					
IAEA Safeguards Support	●	●		●			

protocols, vaccine potency and safety testing, and integrated alternative approaches in toxicity testing studies.

- The European Technical Office for Medicinal Products (ETOMEP). This office, which forms part of a unit at EI, is established both in London, at the European Medicine Evaluation Agency, and in Ispra, at the Environment Institute. It is dedicated to the development of technical systems necessary for the implementation of European Union legislation on medicinal products. Its work is of direct and immediate use to the European Medicine Evaluation Agency, the Member States, and pharmaceutical regulatory bodies.

- Support for the elaboration of methodologies for the EU antifraud policy (UCLAF), via the effective development, introduction and use of new information technologies and data and risk analysis methods.

- Support services related to the Alpine Observatory (Alpine Convention), with the aim of producing and/or collecting data, indicators and information characterising the environmental and socio-economic status of the Alpine region. These data will be useful to the National Communication Centres, for distribution at national level.

- The Major Accident Hazards Bureau, which supports the "Seveso" Directive on industrial hazards by

operating the Major Accidents Reporting System (MARS) and the Community Documentation Centre on Industrial Risk. End users include all the actors in the legislative and regulatory process concerned with plant safety, such as national and local authorities, industry and safety practitioners.

- The JRC also provides institutional support to the European Environment Agency (EEA-Council Regulation 1210/90).

2. JRC Support for the Common Agricultural Policy (DG VI), which accounted for 17% of the Scientific and Technical Support budget. Work is carried out mainly in the following research areas:

- Research and development of new verification methods and instruments for verification for improved animal identification, in order to prevent fraud. An identification system was under preparation, including electronic identifiers, readers, data acquisition systems, control strategy, data base and data transmission techniques with headquarters evaluation.

 The technical features of a large scale pilot project, IDEA, for electronic animal tagging with passive transponders, were prepared. The tagging of one million animals in various countries of the EU is contemplated.

- Quality control of foodstuffs, by supplying certified reference materials, providing suitable analytical procedures, and supplying and/or coordinating laboratory intercomparisons for evaluation and improvement of existing methods and development of new methods of analysis.

- Application of remote sensing to agricultural statistics, with the aim of developing and demonstrating methodologies which can integrate remote sensing data into the collection of statistics for the monitoring of crop acreage and agricultural production in the EC.

- Monitoring and control of the Common Agricultural Policy: research and development of new remote sensing techniques allowing improved monitoring and control of the Common Agricultural Policy.

- Implementation of Community wine sector legislation through the operation of the "European Office for Wine, Alcohol and Spirit Drinks" (BEVABS). The work focuses on the control of adulteration and of the origins of wine, using nuclear magnetic resonance (NMR) and mass spectrometry (MS) techniques, with the aim of setting up a European Union Wine Data Bank. Some 4 000 EU NMR wine data have been validated to be stored in the relevant data bank.

3. JRC Support for Nuclear Safeguards (Euratom Safeguards DG XVII, IAEA Safeguards support programme DG I) accounted for 32% of the scientific and technical support budget.

Most of the work undertaken dealt with the following tasks:

- Training of inspectors, harmonisation of in-service nuclear safeguards inspection practices, providing state of the art equipment and reference analyses of nuclear materials samples.

- Design of on-site laboratories for safeguards analysis at reprocessing plants such as Sellafield and La Hague; routine analysis of nuclear materials samples; examination of the purchase and testing of major equipment, including the construction of two analytical boxes, and the training of analysts.

- Work on non-destructive assay, sealing and identification techniques, surveillance techniques, testing of safeguards equipment, data information treatment, health physics and training.

Other Institutional Scientific and Technical Support activities deal with:

- Safety and reliability of informatics systems, for DG III.

- Foodstuff analysis in support of the industrial policy, for DG III.

- Quality control of consumer products (consumer protection), for DG XXIV.

- Techniques for inspecting ageing nuclear components, in support of DG XI and DG XVII.

Competitive Activities

In the past, the JRC carried out research on a competitive contractual basis for external clients, the so-called "work for third parties". The discussions in the Council and the European Parliament leading to decisions on the EC Fourth Framework Programme as well as the EURATOM Framework Programme emphasised the need for the JRC to thoroughly reinforce its move towards a competitive approach, on the basis of a genuine customer/contractor relationship, as stated in the Council Conclusions of April 1994 on the role of the JRC.

The full spectrum of competitive activities, as given in the guidelines of the Council Conclusions, were, for 1996:

Under the Framework Programmes:

- Participation of the JRC in Shared-Cost Actions:*

 The JRC, in association with partners in the Member States, submitted proposals in the context of calls for proposals issued by the Commission.

- Competitive support actions:

 Scientific and technical support activities requiring a competitive approach, where the JRC responded to requests from the Commission's other Directorates-General. These activities were allocated on a competitive basis in the context of invitations to tender.

Outside the Framework Programmes:

- Activities under contract:

 The conduct of research and supply of services under contract to third parties, including contracts secured in the context of the of Member States' RTD Programmes.

- Other Community Activities:

 JRC's participation in Community actions (e.g. PHARE, TACIS, co-operation with developing countries, etc.) where Community funding is obtained in the context of a competitive approach.

The Council conclusions stated that the shift towards competitive activities should average 22% for the EC Framework Programme and 10% for the EAEC Framework Programme from 1995 to 1998, and that this transition should be a gradual and progressive process over the four-year period. Accordingly, the Council in its conclusions invited the Commission to amend its internal rules as needed and to propose to the Council all necessary decisions. The Commission reported during 1996 on progress to the Council and European Parliament.** A further report is foreseen at the end of 1997.

Participation in shared-cost actions continued in 1996. In response to further calls for proposals, the JRC and its partners presented 210 proposals. In its review for 1996, the JRC noted fewer calls for proposals than were issued in 1995 or at the end of 1994.

It is noteworthy that the JRC, associated with partners in shared-cost actions, has made applications, and has had applications accepted, both in Framework Programme themes corresponding to JRC institutional activities, and in other themes, e.g. telematics, advanced communication technologies and services, or marine sciences and technologies.

This illustrates the fact that the JRC is now a fully multi-disciplinary research centre, which can develop scientific disciplines outside the prescribed Framework Programme themes and can be successful in the competitive arena.

Competitive activities in support of Commission services continued, while a part of the contracts gained by the JRC in 1995 were signed in 1996 only and work started later in the year. New contracts gained in 1996 amount to 10,6 Mioecu but, as for last year, signature of a large part of these contracts will only take place in 1997.

Examples of S/T support activities where the JRC successfully bid in response to Commission services calls for tenders can be found in the following areas:

- information management systems and general Information Technologies support work;
- systems support to environmental problems as well as to non-nuclear energies;
- remote sensing applications in support to the Common Agriculture Policy;
- support for efforts to transfer technology arising from EC research.

Outside the Framework Programmes, the JRC has gained contracts in other actions introduced by the Community, namely from the PHARE and TACIS programmes. These total some 4,2 Mioecu and include:

* "Shared Cost Actions" are specific programmes under the Framework Programmes where accepted projects are financed partly by the programme resources and partly by the own resources of the proposers.

** COM(96) 436 final, 6.9.1996.

- A major PHARE project on agricultural information systems, including applications of remote sensing for six PHARE countries. Extensions are foreseen for five more PHARE countries, and the project may be extended in following years.

Alongside these new types of activity, the JRC continued to work under contract. New contracts in 1996 totalled 13,6 Mioecu. Recent contracts being carried out include:

- Continuing work for the US Nuclear Regulatory Commission on a major experimental installation in Ispra.
- Establishment in a Member State region of a centre for the prevention of pollution and risks associated with the handling and transportation of toxic substances.
- Nuclear instrument development for a large nuclear industrial firm in a Member State.
- Development of numerical methods for the simulation of the behaviour of concrete structures for a national electricity utility.
- Development of ultrasonic systems for monitoring liquid circuits for an industrial company in a Member State.

HFR SUPPLEMENTARY PROGRAMME

The High Flux Reactor (HFR) at Petten is operated by the Commission in accordance with the Euratom/Netherlands agreement of 25 July 1961. On 27 June 1996, the Council adopted a four-year supplementary research programme to be implemented by the Joint Research Centre for the European Atomic Energy Community (1996-1999) concerning the operation of the High Flux Reactor (HFR) at Petten. Under previous supplementary programmes, the activities of the HFR were essentially the outcome of co-operation between two partners, Germany and the Netherlands. The new supplementary programme introduced two major changes. On the one hand, the co-operation was enlarged to include France, which decided to support the HFR. On the other hand, besides traditional work for the nuclear R&D and industry, it was decided to dedicate a large part of HFR activities to medical applications. On the basis of contractual relationships, the reactor will be a major contributor to the production of medical radioisotopes for the needs of the European radio pharmaceutical industry. Furthermore, it was planned to use the unique possibilities offered by the HFR for the treatment of glioma, a highly malignant cancer of the brain.

Competitive Activities (Mioecu)

The figures are apart from the activities related to the HFR reactor at Petten (NL). In 1995 a particularly large contract was signed for third party work in a Member State region over a number of years.

Table 3

	Inscribed in 1995 accounts	Inscribed in 1996 accounts
Shared-Cost Actions	3.9	9.8
Competitive Support	4.8	10.6
Competitive Activities outside the FWP	1.3	4.2
Third Party Work	18.5	13.6
Total	**28.5**	**38.2**

JRC Information Days, Publications and Conferences

The new approach to JRC activities calls for closer collaboration with industry, research centres and universities in the Member States. Therefore, to promote better awareness of the JRC, Information Days were organised at the initiative of Members of the Board of Governors in Dublin, Ireland and Espoo, Finland. Similar Information Days had been held in other Member States in previous years. JRC staff presented the Centre and, in parallel, workshops representing the Institutes established the basis for new collaborations. An Information Day more targeted to nuclear applications took place in Stockholm, Sweden, and another one on environmental and remote sensing activities took place in Reykjavik, Iceland. Following a day of presentations and discussions at each of the above events, the JRC participants had meetings and contacts with industry, research centres and universities. These Information Days thus supplemented the numerous presentations of the JRC given to visitors on the sites, visits made to national laboratories, presentations of the JRC at specialised fairs and exhibitions, and distribution of JRC literature.

The JRC offers a vast array of publications on scientific matters, ranging from papers and articles published in scientific magazines, to conference papers, EUR reports, reviews, and information about the JRC posted on INTERNET.

In 1996 the JRC published in total around 1,180 papers, and their distribution by Institute is shown in *Table 4*.

The detailed list of JRC publications is published each year in the *Publications Bulletin*. The last issue, No. 16, published in March 1996, lists all publications issued in 1995.

Most of these publications are available upon request from the Public Relations and Publications Unit, Ispra.

In addition to publications, the above mentioned *Bulletin* lists all patents obtained by the JRC. There were 9 patents granted in 1996.

Each year, the JRC organises a number of conferences, workshops and seminars at its five sites in Europe. In 1996 there were 9 conferences, 138 international workshops and meetings, and 130 visits to the various sites. The resulting total of about 11,000 visitors shows the constant interest of the scientific community in the contributions to research and development made by the JRC.

JRC Publications in 1996

Table 4

Institute	EUR Reports	Confer. Papers	Articles Published	Special Publicat.	TOTAL
General Management	2	•	•	8	10
Institute for Reference Materials and Measurements	2	87	19	•	108
Institute for Transuranium Elements	2	89	42	•	133
Institute for Advanced Materials	15	121	6	11	153
Institute for Systems, Informatics and Safety	36	177	34	22	269
Environment Institute	36	200	60	15	311
Space Applications Institute	21	85	29	20	155
Institute for Prospective Technological Studies	33	6	•	9	48
Total	**147**	**765**	**190**	**85**	**1.187**

Human Resources

The JRC's statutory staff is made up of officials and temporary agents, including both scientific-technical and administrative staff.

By the end of December 1996, the statutory staff numbered 1,746 agents, as compared with 1,786 in December 1995. *Table 5* gives the distribution of statutory staff in 1996. Beside normal mobility, a number of staff members retired in 1996, having reached the statutory age limit. Recruitment for replacements was in progress at the end of the year.

In addition to statutory staff, 186 scientists were also active in the JRC under various hosting schemes:

- senior scientists hosted as visiting scientists;
- national experts seconded to the JRC by Member States, to participate in selected scientific work;
- post-doctoral scientists and post-graduate students trained through a programme of fellowships.

Table 6 gives the distribution, by Institute, of these scientists working at the JRC at the end of December 1996.

In addition, about 21 scientists each year come from a third country, assisted by a grant within the framework of a Commission agreement with their countries or with the International Atomic Energy Agency (IAEA).

Besides the above mentioned scientists, several senior scientists and about 183 trainees work at the JRC Institutes at no cost to the EU budget, in general for short periods of time.

Distribution of statutory staff

Table 5

Directorate General	34	as of December 1996
Programmes Directorate	8	
Resources Coordination - Scientific & Technical Support Ispra	428	
Institute for Reference Materials and Measurements	181	
Institute for Transuranium Elements	186	
Institute for Advanced Materials	267	
Institute for Systems, Informatics and Safety	276	
Environment Institute	222	
Space Applications Institute	100	
Institute for Prospective Technological Studies	35	
JRC staff seconded to national bodies	9	
Total	**1.746**	

Visiting scientists, seconded experts, grantholders

Table 6

Institutes	Visiting Scientists	Seconded Experts	Post-Doc. Scientists	Post-Grad. Scientists	Total	
Institute for Reference Materials and Measurements	1	1	10	20	32	as of December 1996
Institute for Transuranium Elements	•	•	7	6	13	
Institute for Advanced Materials	2	•	12	14	28	
Institute for Systems, Informatics and Safety	4	2	11	11	28	
Environment Institute	3	1	1	1	1	
Space Applications Institute	2	5	9	15	31	
Institute for Prospective Technological Studies	3	•	6	7	16	
Total	**15**	**9**	**63**	**99**	**186**	

Finances

The budget (commitments credits) as implemented by the JRC in 1996, is given in *Table 7*.

To these commitment credits one must add 0.800 Mioecu of credits carried over from the 1995 Budget (related to completion of previous programmes).

Total JRC committed financial resources amounted to 273 Mioecu:

- for the execution of the JRC specific programmes (Research and Institutional support activities for the services of the Commission);
- for the execution of JRC competitive activities within the framework of the EU budget (participation in shared-cost actions, competitive support activities for the services of the Commission, JRC participation in other Community activities, contributions from the Dutch and German governments for the operation of the HFR and from JRC customers for the execution of work at their request.

The financial resources for the specific programmes were provided by the JRC part of the General Budget for the European Union 1996 and the contributions from the EEA (European Economic Area) countries: Iceland, Liechtenstein and Norway for the EC programmes. In addition, there is a contribution from 1996 onwards to the EC programmes from Israel.

1996 Budget implementation in Mioecu (Commitment Credits)

Table 7

Institutional activities	
Information and Comm. Technologies	2.946
Industrial Technologies and Materials Technologies	21.534
Measurements and Testing	26.722
Environment and Climate	74.451
Agriculture and Fisheries	10.849
Non-Nuclear Energy	3.838
Targeted Socio-Economic Research	7.728
Nuclear Safety and Safeguards	63.229
Controlled Thermonuclear Fusion	10.310
SCA EC Programmes	3.013
SCA EAEC Programmes	0.411
Competitive Activities	
Participation to Shared-Cost Actions (SCA)	4.011
Competitive Scientific and Technical Support activities	10.191
Participation to Community activities outside the FWP	1.879
Work for third parties	16.561
HFR Reactor	8.088
HFR Completion of previous programmes	6.262
TOTAL	272.023



Activities of the JRC Institutes in 1996

PART 2

THE INSTITUTE FOR REFERENCE MATERIALS AND MEASUREMENTS

The IRMM promotes and harmonises the use of European standards, reference materials and methodologies at the European level. In 1996, the Institute pursued its specific programme under the heading of Measurements and Testing and contributed to the Framework Programme line "Industrial Technologies and Materials Technologies". IRMM consolidated its responsibility for managing the BCR's (Bureau Communautaire de Référence) reference materials.

IRMM is also engaged in support activities for Community policies related to nuclear safeguards, the safety and quality control of consumer products, and reference measurements and materials for quality control of foodstuffs. It provides services and reference materials to various customers from the European Member States.

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

As in the previous years, the measurement expertise and refined analytical techniques of the Institute have been applied to prepare, characterise and certify high quality reference materials in both the nuclear and non-nuclear fields, in order to establish a co-ordinated analytical measurement system at European level. Within this framework, IRMM is now responsible for storage, stability control, distribution, sales administration and recertification of BCR certified reference materials.

Biomedical Certified Reference Materials

A major route into the field of reference materials has been opened with a new co-operation agreement between IRMM and the International Federation of Clinical Chemistry (IFCC) for the production of certified reference materials of biomedical relevance. This agreement, signed by Mme Edith Cresson, the European Commissioner for Science, Research and Development, will significantly enhance the Commission's role in the development of biomedical certified reference materials. These are crucial for carrying out rapidly and reliably accurate diagnoses in laboratories (an essential starting point for good quality health care). By significantly reducing the risks of diagnostic errors, certified reference materials raise the quality of patient treatment while also helping to curb healthcare costs.

Under the agreement, laboratories and scientists around the world will be involved in providing reference

materials needed by industry and clinical laboratories. They will be produced on the basis of projects proposed by IFCC and their validity will be certified by the IRMM.



Installation for grinding, mixing and sampling to be used for the preparation of high quality reference materials

Research on biological and environmental materials was carried out with the isolation and stabilisation of chloroplasts suitable for the bio-assay of pesticide traces in drinking water control.

An effort was made to increase significantly the capabilities for production of reference materials, from powder to liquid samples, basically with the aim of producing certified solutions containing dioxins and furans. Analytical research was pursued on metallothionein characterisation by electrochemistry and liquid chromatography, and on heavy metal traces of environmental or bio-medical relevance, with the aim of producing new reference materials.

The neutron activation analysis facility set up in collaboration with the SCK/CEN at Mol (B) is now operational for quality control during the preparation and certification of reference materials.

The IRMM continued to use the two strong neutron sources of the Institute (LINAC and 7 MV Van de Graaff) to perform neutron data measurements for applied purposes following the recommendations of the OECD-NEA Nuclear Science Committee, in particular its Working Party on International Evaluation Co-operation.

Work related to nuclear matters included, *inter alia*, the supply of targets for neutron cross-section measurements, fission fragment studies and other applications; the refurbishment of techniques for electrodeposition of actinides and the development of methods for high yield reduction of oxides for the preparation of stable isotope metal targets. The measurement of neutron total and absorption cross sections for ^{99}Tc and ^{237}Np in the resonance region needed for waste transmutation work is being studied in close collaboration with CEA (Commissariat à l'Energie Atomique), Saclay (F), the investigation of the Doppler broadening of neutron resonances with the laboratories of CEA, Cadarache (F) and ILL (Institute Laue-Langevin) (F), a safety parameter important for the calculation of the temperature coefficient of reactivity of reactors.

In response to a long-standing request from the Joint European File (JEF) project, the cross sections for inelastic scattering from low-living levels of molybdenum isotopes have been measured. Other important, accurate measurements were performed in order to improve the set of nuclear data measurement standards. The neutron total cross section of ^{10}B and the fission fragment mass yield distribution and fission neutron spectrum of ^{252}Cf have been investigated. Improved methods of measuring the $^{235}U(n,f)/H(n,n)$ cross section ratio are being developed. Also, as an extension of the LINAC facility, a new laboratory is being completed, to develop non-nuclear applications in the field of radiation physics.

Institutional Support Activities

IRMM's support activities were mainly related to Nuclear Safeguards at the request of DG I (External Relations), for the International Atomic Energy Agency (IAEA) and DG XVII (Energy, Euratom Safeguards Directorate). But numerous non-nuclear certified reference materials were also prepared for other DGs. The following activities highlight work carried out as institutional support to other Directorates General:

- Work on dried nitrate or metallic spike material was continued, to improve safety at large processing plants, and uranium and plutonium isotopic reference materials were prepared on behalf of DG I for IAEA. Low concentrations implied meticulous chemical work in IRMM's ultraclean chemical laboratory.

- IRMM provided DG XVII (Energy) with solutions for detector calibration needed in non-destructive assays of uranium and plutonium.

- Certified reference materials of foodstuffs were prepared for DG III (Industry) and DG VI (Agricul-

ture), for quality control to assist enforcement of European legislation. For DG VI, new activities were initiated on selenium speciation. Cosmetics analyses and a product safety data bank were under further development for DG XXIV (Consumer Policy).

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions

deal with:

- the preparation and certification of a set of organic and inorganic reference materials for the measurement of rare earth elements;
- the preparation and certification of a sludge reference material for the measurement of polychlorodibenzo-p-dioxins (PCDD) and polychloro-dibenzofurans (PCDF) contaminations;
- the preparation and characterisation of catalytic converters with respect to platinum, rhenium, zirconium and cerium;
- the preparation of bronze reference materials for corrosion studies on bronze antiquities.

Competitive Support Activities

A contract was concluded via DG XIII (Telecommunications, Information Market and Exploitation of Research) with an SME (Small and Medium Enterprise) aiming at the validation of a ^{13}C isotopic measurement method which can be applied to the diagnosis of stomach diseases by a non-intrusive inexpensive technique based on the isotopic measurement of exhaled breath.

Research under Contract

IRMM services and reference materials are also available on a commercial basis. As IRMM now manages the BCR's reference materials, these are also being made commercially available for non-nuclear applications.

Traceability and Accreditation

IRMM signed co-operation agreements with several European Standards Laboratories to ensure that chemical measurements at these national standards institutes can be made traceable to the international standard (SI) system (with reference to the Avogadro Constant measurements at IRMM).

In this context, the European Co-operation for Accreditation of Laboratories (EAL) has requested the JRC to provide Reference Measurements through IRMM's International Measurement Evaluation Programme (IMEP). This gives an idea of the true measurement abilities of interested laboratories, by comparing their results on blind samples against values which are traceable to the SI system, the internationally agreed system of Quantities and Units under the convention of the Metre. EAL considered the satisfactory performance of the IRMM programme as an asset in the accreditation of measurement laboratories.

The International Measurement Evaluation Programme (IMEP) is arousing interest in a growing number of laboratories. The most recent IMEP round on trace elements in water was concluded. Comparative performance surveys for more than 300 laboratories worldwide were evaluated.

The Regular European Interlaboratory Measurement Evaluation Programme (REIMEP), an external quality control exercise, recently brought together 20 laboratories worldwide in round-robin tests on uranium oxide powder and two uranyl nitrate solutions.

The supply of nuclear samples to external customers, in particular for reactor neutron dosimetry, was continued. A uranium doped glass reference material for fission track dating of geological samples was prepared.

THE INSTITUTE FOR TRANSURANIUM ELEMENTS

The safety of actinides in the nuclear fuel cycle continued to be the major institutional contribution of the Institute to the Framework Programme line Nuclear Fission Safety. Major research areas were basic actinide research, safety of nuclear fuels, mitigation of long-lived actinides, and spent fuel characterisation.

ITU also provided scientific and technical support for Community policies in the area of nuclear safety and safeguards, predominantly related to the implementation of on-site laboratories at Sellafield and Cap la Hague, but also related to nuclear safety in Eastern countries and the Russian Federation. In addition, ITU continued to carry out contractual work at the request of various customers.

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

Basic actinide research is needed to elucidate the electronic structure of actinide elements and point out their interest for chemistry and solid-state physics. Important results have been obtained in the understanding of uranium-based heavy-fermion superconductors doped with neptunium and plutonium. Other themes include the use of pressure to study trends in structural transitions and changes in resistance at low temperature; the theory of light solid interactions; and the use of neutron and synchrotron experiments to complement the bulk-property measurements.

In the area of safety of nuclear fuel, porosity distribution and mechanical properties of fuel at very high burn-up were measured and evaluated. Structural properties of fuel with simulated burn-ups of up to 200 GWd/t were examined and compared with real high burn-up fuel to better understand the rim effect formation processes. Oxidation and creep measurements on SIMFUEL were carried out, and radiation damage studies on UO_2 yielded for the first time direct visible evidence of tracks of fission fragments in this material.

The fuel performance code TRANSURANUS was further amended with data from high burn-up fuel. A new sol-gel installation for the production of actinide-bearing fuels is undergoing final commissioning.

These activities contribute to improving nuclear safety, particularly in phenomena which occur in light water reactor fuel rods for extended times of operation. Fuel fabrication technologies are also being improved. This work is addressed to operators of nuclear reactors and fuel fabrication plants, and national and international authorities in charge of licensing and regulation.

In the area of spent fuel characterisation, the investigation of the oxidation kinetics and corrosion effects of irradiated UO_2 and MOX fuel was prominent. Leaching tests on UO_2 and on fuel rod segments with pre-set defects were carried out. The chemical interaction of fuel and cladding was further investigated. Extensive work to study the leaching of simulated high burn-up fuel was carried out, leading to an explanation for the buffering behaviour of molybdenum on the oxidation potential of spent fuel. Non-destructive measurements, based on CdTe detectors, were performed on spent fuel under hot cell conditions. This work is targeted to characterisation of unprocessed spent fuel and its behaviour under long term storage conditions, determination of its radiotoxic potential, and investigation of leaching of this waste form under various realistic conditions. These activities are mainly addressed to reactor operators, the fuel cycle industry and licensing authorities.

Collaborative work with leading national laboratories takes place mainly in the area of mitigation of long-lived actinides and fission products, with particular emphasis on further reduction of the radiotoxicity of highly active wastes.

Another major task of ITU is the fabrication and characterisation of fuel targets for irradiation experiments and post-irradiation examination, the results being compared with theoretical predictions. New extraction processes for the effective separation of long-lived actinides are tested under realistic conditions.

A New Micro X-Ray Diffraction Technique for the Characterisation of Irradiated Fuels

New methods of material characterisation of irradiated fuels are required for the investigation of the microstructural changes occurring in the fuel at very high burn-up. A microindentation study concerning the mechanical properties of high burn-up fuel was realised in collaboration with the nuclear industry, in order to demonstrate that the fracture toughness of the rim material increases considerably with the accumulated burn-up, mainly as a consequence of the grain size reduction taking place in this region. A new programme for the characterisation of the lattice structure variations of high burn-up fuel was launched, and a new micro-X-ray diffraction system for powder diffractometry was developed with a collimation of the incident beam down to a dimension of 3 X 0.01 mm, allowing the acquisition of diffraction spectra of irradiated fuel samples at intervals as small as 20-30 micrometers in the radial direction. With this system, the structural characterisation of different nuclear and non-nuclear thin interface materials will also be possible, such as for instance those appearing in light water reactor fuel under severe accident conditions.

In 1996, a new fabrication procedure based on the infiltration of radioactive materials (INRAM) into matrices was developed, tested and successfully applied to the fabrication of americium-containing incineration targets, within the EFTTRA irradiation programme (Experimental Feasibility of Targets for Transmutation).

The initial layout of the minor actinide laboratory was modified, and the purchase of major components initiated. Actinides were separated from irradiated fuel on a 100 g scale, including a final separation step for lanthanides. Radiation damage and basic physical property studies were performed on different inert matrices.

In the area of safeguards R & D, the Secondary Ion Mass Spectrometer (SIMS) for the measurement of particles from swipe samples went into operation, and the first environmental samples were received and analysed.

Institutional Support Activities

In support of Community policies in the area of Nuclear Safeguards and Fissile Material Management for DG XVII, major progress was achieved towards the implementation of the on-site laboratory at Sellafield. Analytical procedures and working procedures in accordance with ISO 9001 were completed. Verification measurements on samples taken at Cap la Hague and Sellafield continued.

Routine analytical measurements on samples sent to the Institute continued within the framework of ECSAM (European Commission's Safeguards Analytical Measurements). ITU also continued to receive and analyse seized nuclear materials. A nuclear material data bank was set up, in close collaboration with the Bochvar Institute in Moscow.

Test samples with extremely low concentrations of radionuclides and samples from in-field experiments from environmental monitoring were measured at the request of the IAEA and DG XVII.

B. COMPETITIVE ACTIVITIES

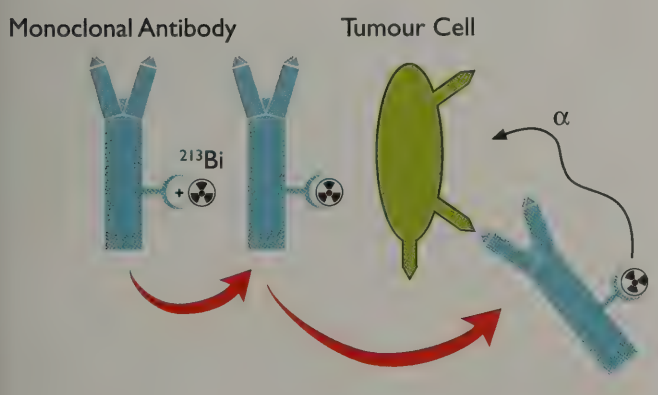
Shared-Cost Actions

One out of two proposals submitted to the second Nuclear Fission Safety Programme call for tender was accepted, on the investigation of corium interactions and thermochemistry. The overall objective of the project is to provide new data on key properties and characteristics of "prototypic corium" which may be formed under severe reactor accident conditions inside or outside a reactor core.

Pioneering Work on Alpha-radioimmunotherapy

When alpha-emitters are conjugated to tumour-seeking monoclonal antibodies, the resulting product may become a powerful cancer therapeutic tool. Pioneering work on alpha-radioimmunotherapy for the treatment of metastatic cancers was performed at ITU. Three projects are being carried out:

- *Production of ^{225}Ac through irradiation of ^{226}Ra in a cyclotron using a proton beam.*
- *Use of ^{213}Bi and ^{225}Ac for killing multiple myelomic cancer cells present in human bone marrow, in collaboration with "Ecole des Mines" and INSERM (Institut National de la Santé et de la Recherche Médicale) in Nantes.*
- *Clinical trials done on patients with acute myelogeneous leukemia in the Memorial Sloan Kettering Cancer Center in New York, using ^{213}Bi-immunotherapy. The results of the first treatment of two patients confirm that the drug is behaving in the human body as predicted from the pre-clinical data.*



Antibody chelation and specific tumour antigen of an alpha-emitting radio-immunoconjugate

Research under Contract

As in previous years, the work carried out for various customers concerned post-irradiation examination of irradiated fuel, fabrication and characterisation of fuels for transmutation, and examination of high burn-up oxide and mixed oxide fuels.

Other Competitive Activities

The following proposals were submitted to the TACIS/PHARE programmes:

- Assistance to Hungary, the Czech Republic and Bulgaria, for fighting illicit trafficking of nuclear material.
- Co-operation with MINATOM and Gosatomnadzor in setting up analytical facilities in the Russian Federation for nuclear material accountancy and control.
- Co-operation with the Leningrad Nuclear Power Station to improve the safety of nuclear fuel.
- Co-operation with the Czech Republic in the area of fuel modelling to improve the safety of reactor operation.

THE INSTITUTE FOR ADVANCED MATERIALS

IAM performs research on advanced materials. The research activities were carried out within the four following Framework Programme lines: Industrial Technologies and Materials Technologies, Non-Nuclear Energy, Nuclear Fission Safety, and Controlled Thermonuclear Fusion.

IAM developped in 1996 some valuable contributions to science and technology, with the concept of a new pressure vessel for the petro-refinery industry, a fibre tow transport system for continuous coating of endless fibres, and a chemical vapour deposition process, all of them to the benefit of European industry. IAM also initiated new activities on the development of new production techniques for medical radioisotopes, which will improve health care for European consumers.

1996 was also the first year of the new HFR (High Flux Reactor) supplementary programme for the European Atomic Energy Community (1996-1999). Besides traditional work for nuclear R&D and industry, a large part of the HFR's activities was dedicated to medical applications, through research on materials under irradiation and on Boron Neutron Capture Therapy (BNCT), a new therapy for brain cancer tumours. The production of medical radioisotopes on a commercial basis will continue and increase.

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

The *Industrial Technologies and Materials Technologies* programme carried out at IAM covers four main topics: advanced materials and standards for industrial innovation, surface engineering for improved properties and for new industrial applications, recycling and materials eco technology, and non-destructive evaluation, testing and inspection of industrial structural components.

The *Non-Nuclear Energy* programme consists of two main research lines: photovoltaic energy and materials for clean technologies. The first mainly deals with standardisation of photovoltaic devices, while the second concentrates on new catalytic car exhaust systems.

The *Nuclear Fission Safety* programme includes a contribution from IAM in the form of the European Networks on component ageing, inspection techniques and structural integrity. These Networks are particularly focused on the ageing of materials used in nuclear reactors.

The *Controlled Thermonuclear Fusion* programme at IAM is mainly carried out within three activity lines: fluid separation and structural analysis, fusion materials, and tritium-materials interaction.

Transmutation Studies

The first irradiation experiment at the HFR on Technetium transmutation has been successfully terminated at a transmutation rate of approx. 6,5%. The irradiated experiment has been investigated at the Petten hot cells of the ECN (Energieonderzoek Centrum Nederland). A new sample has been prepared from the irradiated material, for continuation of the irradiation in a second phase. The irradiation with the second sample is in progress, and will be pursued to a transmutation rate of 20%.

Another irradiation experiment on the transmutation of Americium in an inert matrix has been started successfully during the third quarter of 1996 at the High Flux Reactor (HFR). The test originates from the Nuclear Fission Safety Programme of the European Commission, and is performed by the Experimental Feasibility of Targets and Transmutation (EFFTRA) groups' laboratories and institutes. The target sample consists of 11.9 weight % AmO_2 in an inert matrix. It was produced by the Institute for Transuranium Elements (ITU) by a novel technique which is subject to a patent. The irradiation will last for approx. 400 full power days and yield an actinide burnup of >35%.



Fabrication of preforms for fibre-reinforced ceramic-matrix composites

The relevance of IAM research activities for industry can be illustrated by the following examples, for each of which a patent proposal has been issued.

- Firstly, the concept of a new pressure vessel for the petro-refinery industry, designed to avoid hydrogen attack of the vessel walls. This concept has now reached the stage of a demonstration project (financed by DG XIII (Telecommunications, Information Market and Exploitation of Research, in the framework of the valorisation activity) and will provide increased vessel life, enhanced safety for workers, and decreased wall thickness, as compared to current designs.

- The second example is a fibre tow transport system for continuous coating of endless fibres. The innovative fibre tow transport system simplifies enormously the fibre processing steps involved in the fabrication of ceramic matrix composites by performing, in a single stage, cycling and recycling operations for sequential fibre treatment.

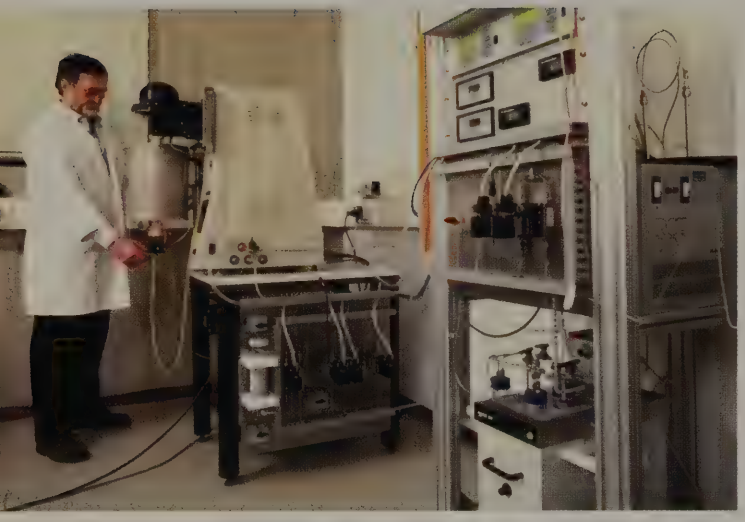
- The third example is a chemical vapour deposition process for the production of 3-dimensional shaped microstructural coatings for functional applications, which combine resistance to wear and self-lubrication, two usually incompatible properties.

Institutional Support Activities

IAM provided support to DG XI (Environment, Nuclear Safety and Civil Protection) through the European Networks AMES (Ageing Materials Evaluation and Studies), ENIQ (European Network for Inspection Qualification, and NESC (Network for Evaluation of Steel components); and to DG XVII (Energy) within the framework of Nuclear Safety and Safeguards. For DG XI, strong assistance was given to the working group on codes and standards and to action groups on inspection and manufacturing, fracture mechanics, and materials. For DG XVII, participation and support were provided to the forum ENDEF (European Non-Destructive Evaluation Forum) and its interaction with Russian and Czech experts.

Thin Layer Activation Electrochemical Test Facility

A new experimental facility at IAM, using the innovative Thin Layer Activation (TLA) method, will make it possible to study metal surface degradation processes, such as corrosion and wear, by using radiotracers. This applies in particular to heavy metal release due to corrosion in, e.g., the food processing and pharmaceutical industries and to biomaterial applications in life science studies. Very low concentrations can be monitored in this way thanks to a gamma spectrometry facility.



Facility for thermogravimety with gas mixing and analysis station for high temperature corrosion testing up to 1700° C

1996 also saw the launching, at IAM, of a new project dealing with Positron Emission Tomography, which should establish a European Network; this Network will host medical staff from all over Europe at Ispra, where new diagnostic and therapeutic techniques will be developed, which they can afterwards transfer to their own home institutions.

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions

IAM participated in 1996 in proposals for Shared-Cost Actions. The total number of proposals was comparable to last year's with, however, a better distributed portfolio across the different shared-cost programmes. This reflects the new structure of the Institute, in particular the new units on structural materials and tritium technology and energy system testing.

Competitive Support for Community Policies

Eight proposals to the Valorisation Programme of DG XIII were successful: they cover the following themes:

- life sciences, with a project on medical image processing software;
- materials science, with a project on crack detection by camera;
- structural integrity, with a project on improving the resistance of reservoirs to hydrogen attack;
- software development for corrosion test management;
- tritium technology, with a project on tritium removal from water;
- composite processing technology, with a project on brake disks.

Research under Contract

New contracts signed in 1996 deal with personal computer based high temperature materials data base software, non-destructive evaluation techniques, coatings technologies, and corrosion studies on materials for power generation.

Other Competitive Activities

IAM continued to be involved in projects related to TACIS and PHARE activities, at a level comparable to the previous year. Among these, one contract was signed with a major nuclear company to perform work on in-service inspection of primary circuit components.

THE INSTITUTE FOR SYSTEMS, INFORMATICS AND SAFETY

ISIS is the JRC's centre of expertise in the science and technology of safety management, the multi-disciplinary analysis of industrial, socio-technical and environmental systems, and the innovative application of information technology.

It contributed in 1996 to the Framework Programme lines Environment and Climate, Non-Nuclear Energy, Nuclear Fission Safety, Controlled Thermonuclear Fusion, and Measurements and Testing. Work at ISIS focused on several fields, including nuclear safety and safeguarding of nuclear materials, industrial and transport safety, seismic protection of buildings and civil engineering works, natural resource and environmental management, support to antifraud measures, and last but not least, the preservation of cultural heritage and architecture.

In addition, ISIS provided scientific and technical support for Community policies in the fields of: safeguards, for DG I (External Relations) and DG XVII (Energy); safety and licensing issues in the nuclear, chemical and biotechnology industries, for DG XI (Environment, Nuclear Safety and Civil Protection); information technology, for DG III (Industry); and fraud control, for DG VI (Agriculture)–in particular, tagging for identification of animals–and the Commission antifraud service (UCLAF).

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

ISIS research work on safeguards prepared to meet future demands from inspectorates and plant operators:

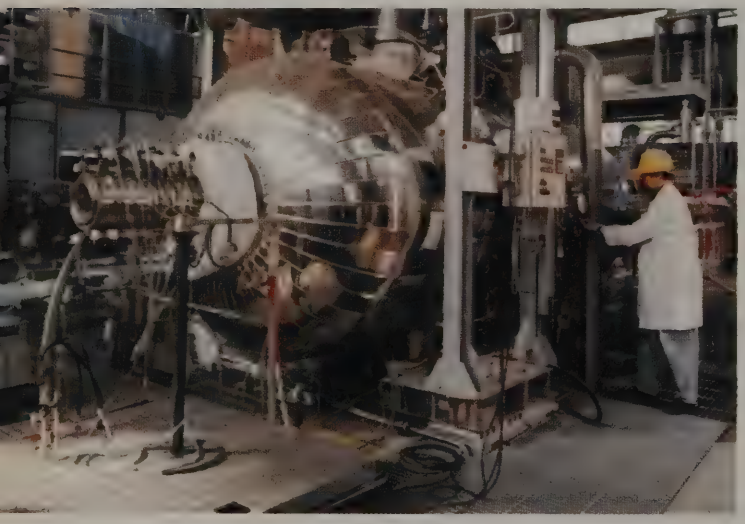
- In the field of non-destructive techniques, an analytical dead time correction algorithm for passive neutron detection was developed, and a high efficiency passive neutron counter was constructed, with a relatively low dead time.
- The TAME (Tank Measurement) facility is now operational, and several tank calibration exercises have been conducted.
- The ultrasonic identification of seals is being investigated, especially for sealing containers of irradiated and non-irradiated fuel assemblies or powders in storage areas.
- The TEMPEST laboratory has been upgraded to meet increased requests for instrument testing.

- As to surveillance systems and mobile robotics technology, studies are being conducted on the use of laser range finders for real time localisation of a mobile robot.

In the area of nuclear safety, experiments were aimed at better understanding the progression of severe accidents and at improving the codes used to analyse how best to mitigate the consequences.

The FARO (Fuel melting and Release Oven) and KROTOS facilities at Ispra were used to carry out experiments where molten mixtures of uranium dioxide and zirconium dioxide are dropped into water in order to observe such phenomena as mixing, jet break-up, quenching, and the risk of explosion with representative materials.

The European Laboratory for Structural Assessment (ELSA) continued to provide a unique test facility for applying pseudodynamic test methods in order to check the seismic resistance of structures, especially bridges.



STORM: Investigation of aerosol behaviour in nuclear accidents and in industrial equipment

Aerosol Transport Phenomena

At present, STORM (Simplified Tests on Resuspension Mechanisms) is the most representative facility in Europe for investigating aerosol transport phenomena in reactor coolant circuits. Eight tests on the deposition and resuspension of solid tin dioxide particles were successfully performed in 1996. The aim is to simulate the transport of aerosol particles through the pipework of a nuclear reactor under accident conditions.

An unexpected finding was the importance of the thermophoresis mechanism during deposition.

International interest was demonstrated by a wide participation at the two meetings of the Scientific Committee and by the agreement of five partners (ENEL, Italy, CSN, Spain, CIEMAT, Spain, Risø, Denmark, and PSI, Switzerland) to provide manpower for test preparation and analysis.

A new precision impact testing method for improving car safety was designed and developed: the use of a new stress wave transducer in the Large Dynamic Testing Facility (LDTF) allows load, displacement and energy flow to be measured in any part of a vehicle body, so that numerical models of vehicles can be calibrated and validated.

ISIS continued to provide support for Centre for Earth Observation (CEO) projects to promote the use of satellite-based earth observation data. Two systems, the European Wide Service Exchange (EWSE), and the G7-ENRM (Environmental and Natural Resources Monitoring) were designed and implemented. These systems allow organisations to publicize their earth observations on the Internet without having their own Web server.

Institutional Support Activities

ISIS offered technical support to the Euratom Safeguards Inspectorate and provided the technical means whereby DG I (External Relations) supported the International Atomic Energy Agency (IAEA) at Vienna. S/T support was offered to the Safeguards Directorate of DG XVII (Energy) for the implementation of nuclear safeguards as required by the EURATOM Treaty.

The most significant activities were the following:

- A remote monitoring link between Ispra and Luxembourg through an ISDN (Integrated Services Digital Network) connection, using commercial equipment.
- An unattended measurement station for the determination of ^{235}U in LWR (Light Water Reactor) fuel assemblies.
- The delivery of sealing bolts to be installed in a spent fuel storage pond.
- An important increase of the environmental testing of safeguards equipment.
- Extensive field tests on a new surveillance system of a Pu storage area based on heat flow meters.

- Training courses for EURATOM inspectors on non-destructive assay techniques and mass and volume measurements of liquids in large tanks.

S/T support was provided to IAEA for its technical activities in the framework of the Non-Proliferation Treaty and the corresponding Safeguards Agreements with the EC Member States. The activities are mainly oriented to the development, testing or adaptation of methods and instruments and to inspector training:

- Environmental testing of safeguards equipment, under thermally, mechanically and electromagnetically induced stresses.

- Several demonstrations on sealing equipment of PuO_2 transport containers, sealing bolts for spent fuel multielement bottles, and special transport and storage casks.

- Instruments and software for process monitoring for mass and volume determination in large tanks of bulk handling facilities, tested by IAEA in selected facilities.

- A spent fuel monitor, which is now being studied for the rapid verification of U or Pu in containers.

- Training courses for IAEA inspectors on mass/ volume determination of liquids in large tanks and the measurement of spent fuel, using a JRC-developed underwater gamma measurement system.

Animal Identification

The antifraud policy of DG VI (Agriculture) is increasingly based on the technical verification by national and EC inspectors of the declarations made by farmers and associations of the presence and movements of their livestock and their alimentary products. New EC regulations are being defined in these areas, in particular for the electronic identification of cattle and sheep.

The JRC is carrying out the first pilot project on the electronic identification of several thousand of animals, in collaboration with eight European laboratories and organisations. ISIS is developing technical verification systems, for the testing of equipment performance and for the use and evaluation of in-field measurement results. The electronic identifiers, hand-held and static reading devices of several commercial companies have been extensively tested in the TEMPEST laboratory according to a well defined protocol based on international standards. Moreover, a large scale project (called IDEA) on the electronic identification by ear-tags, injectable transponders or bolus-transponders of one million animals (sheep, goats, cattle) in different EU countries has been presented to Member State authorities. The IDEA project is expected to start in January 1997.



Reading station to identify animals with electronic tag. Identification of animals helps to prevent fraud and supports consumer protection

Methods and instruments for the in-field verification of the volume and density of alimentary oil were developed. Field tests were conducted in Southern Italy to determine the performance of the dip tube technique and to evaluate its sensitivity to fraud scenarios.

ISIS's support to the Safety of Nuclear Installations Unit, DG XI (Environment, Nuclear Safety and Civil Protection), involved reviewing technical documents submitted to the Nuclear Regulators' Working Group and the Reactor Safety Group. Earthquake catalogues of areas from the former Soviet Union and Eastern Bloc countries were added to the European Seismic Catalogue.

The Major Accident Hazards Bureau acts on behalf of DG XI to implement the Seveso Directive on industrial hazards by operating the Major Accidents Reporting System (MARS) and the Community Documentation Centre on Industrial Risk.

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions

ISIS won and carried out 40 shared-cost action projects, including 19 additional proposals accepted in 1996, within the Nuclear Fission Safety, Environment and Climate, BRITE, ESPRIT, Copernicus, Joule, and INNOVATION programmes, including:

- In the RESOLV Project, a prototype of an Environment Sensor for Telepresence (EST) was implemented, together with the development of algorithms for three dimensional reconstruction.
- In the Investigation of Core Degradation Project, the swelling of irradiated fuel was modelled.
- The LDTF facility is being used to determine how a reactor pressure vessel can cope with fast impacts following an internal explosion.
- The use of Shape Memory Alloys as a strengthening against seismic shocks is being studied in the ELSA laboratory and in the photonics laboratory.
- Expertise on human factors is being applied to aircraft maintenance and dispatch.
- Computational fluid dynamics tools are being further developed in collaboration with industrial partners.

Competitive Support for Community Policies Participation in Other Community Programmes

Work on fraud control included studies on behalf of the Commission's fraud control body, UCLAF. A report was prepared correlating particular incidences of fraud with country profiles and monetary impacts. A feasibility study of an information system for UCLAF was also completed.

ELSA obtained a contract from DG III (Industry), to improve Eurocode 8, the new European design code for earthquake resistant structures. This required tests on a full-scale three-storey composite (steel and concrete) structure, as well as on a three-storey reinforced concrete frame with irregular masonry infills. A project on the multi-site application of virtual reality was also accepted.

The European Commission, through the TACIS programme, is helping the Russian Federation in its effort to improve its nuclear material accountancy and control. A major project is the creation of the Safeguards Methodological and Training Centre (SMTC), at the Institute of Physics and Power Engineering (IPPE) at Obninsk, to help implement new concepts of nuclear materials management. The JRC has been given the task of designing and implementing the new Centre, in cooperation with IPPE.

The Centre will train plant operators, as well as "domestic" inspectors, in upgraded approaches to the accounting and safeguarding of fissile materials. It will also be a very important forum and meeting point for plant operators and inspectors. The existing premises, already licensed for the use of nuclear materials (U, Pu), are now being equipped with instrumentation for hands-on training. The first Russian-JRC course was held in July 1996 at IPPE, and two seminars were organised at Ispra for the training of future training staff.

ISIS signed a contract with DG XI to check calculations for nuclear reactor accident sequences submitted by a number of organisations.

Work on environmental pressure and environmental impact was done for DG XI (impact studies of installations for the treatment and disposal of toxic and dangerous waste in the European Union) and the European Environment Agency (EEA) (Environmental pressure indicator models).

It is an important part of ISIS's mission to transfer technology developed at Ispra to industry. To do so, the institute bids for funding from DG XIII (Telecommunications, Information Market and Exploitation of Research). In 1996 the following ten spin-off projects were supported:

- Comparative testing of an opto-thermal device.
- Differential thermal and pressure monitoring. Thermal detection systems.
- Exploitation of the batch chemical reactor relief line simulator package RELIEF.
- Industrialisation of advanced adaptive wavelets and fractal compression techniques.
- Electronic speckle pattern interferometry (ESPI) based device for deformation measurement and mechanical characterisation of building materials.
- Interferometric fibre optic sensor for structural real time strain monitoring and damage detection.
- Exploitation of the STARS industrial reliability software.

- Implementation of a commercial generalised software control system for industrial robots.
- An interactive mobile surveillance system.
- A graphical user interface for the gas dispersion and combustion code REACFLOW.

Research under Contract

Three JRC institutes (ISIS, SAI and EI) are working together with 79 departments from the Universities of Catania, Messina and Palermo on a vast regional development plan for Sicily. Major achievements included the use of optical inspection methods, three-dimensional structural analyses and tests in ELSA to understand how the Geraci Palace in Palermo can best be protected against earthquakes.

New projects have been launched on behalf of the Basilicata region and the Italian Ministry of the Environment. ISIS's work concentrated mainly on water resources, cultural heritage, and emergency management following the release of dangerous chemicals.

Moreover, ISIS has received the following commercial contracts:

- A series of tests in ELSA for the Italian association of precast concrete structures producers.
- Seismic tests in ELSA on a replica of the Sao Vicente de Fora monastery in Portugal.
- An IAEA order for 500 sealing bolts was completed.
- A study of a sealing system for a plutonium oxide transport container was carried out for PNC (Japan).
- A plutonium drum monitoring technique has been licensed by ANTECH (GB) and a SuperPhonid uranium monitor by British Nuclear Fuels Limited.
- Studies of aircrew training and stress in air traffic control rooms.
- The impact characteristics measurement of advanced automotive high strength steel and aluminium alloys using LDTF, under contract with the European suppliers.
- A license of the DYLAM-3 Code, developed by JRC-ISIS for dynamic reliability analysis, has been sold for the use of the Ship Research Institute of the Transport Ministry of Japan.

C. EXPLORATORY RESEARCH

A levy of 6% of the institutional budget is used to finance exploratory research. Priority was given to 12 projects covering a wide range of subjects including non-linear time series analysis, brain-actuated control systems for the disabled, voice to text conversion, interactive multimedia for teaching, symbolic modeling of vehicles, regional flood vulnerability, remote measurement of water levels in environmentally sensitive areas, innovative accelerator driven nuclear reactors, modelling particle gas flows, smart materials, seismic monitoring, and stress-wave release from fracturing rocks.

THE ENVIRONMENT INSTITUTE

The Environment Institute contributed to the Framework Programme lines Environment and Climate and Life Sciences and Technologies, complemented by several competitive actions addressing other programmes such as Nuclear Fission Safety, and Measurements and Testing.

An important part of EI activities was a direct support for European Union sectoral policies, in fields as varied as environment, radio-protection and agriculture, with a particular emphasis on food and drug consumer protection.

The Institute Director heads the Environment-Water Task Force established at the initiative of the Commission and intended to contribute to a European strategy for the sustainable management and rational use of water.

A. INSTITUTIONAL ACTIVITIES

The balance between research and direct support activities (30% and 70% respectively) allows the institute to provide effective support while maintaining its scientific competence, as demonstrated by its presence in various international research programmes such as: EUREKA/EUROTRAC, which investigates the impact of human activities on tropospheric chemistry; IGBP/IGAC (International Geosphere Biosphere Programme/International Global Atmospheric Chemistry); WMO/GAW (World Meteorological Organisation/Global Atmospheric Watch).

Institutional Research Activities

Global Change studies deal with research linked to the composition of the atmosphere, the focus being on tropospheric ozone and the role of aerosols in climate regulation.

Aerosols and Climate

Atmospheric aerosols are believed to have an important effect on the Earth's radiative balance. The aerosols and climate project aims at understanding both the key chemical and physical processes governing the formation of atmospheric aerosols, and the role of anthropogenic precursors in these processes, in order to better evaluate the scale of radiative effects. This project combines field work, laboratory studies and modelling activities, in collaboration with European and International research teams.

The study of the dynamics of sulfate aerosols, and the development of models simulating the evolution of

the size distributions of these aerosols on a global scale, is the major aspect of the aerosols and climate project.

An advanced global transport model (TM2) and a simplified aerosol dynamics model (M3) were developed, and M3 was implemented in TM2. An important first step towards assessing the effect of anthropogenic aerosols on the radiative properties of clouds on a global scale has been achieved. In addition, work has been initiated to describe the mixing of sulfate, black carbon, desert dust and seasalt aerosols in TM2.



Set of laminar photochemical fluor reactors for the study of aerosol formation from the gas phase

The Biogenic Emission in the Mediterranean Area (BEMA) project (partially funded by the EC Environment & Climate programme 1994-98) was developed by EI in collaboration with 17 European laboratories. Its main goal was to analyse the type and amount of emissions from Mediterranean vegetation and to understand their role in atmospheric chemistry and ozone formation. In preparation for the second phase (1996-97), the objective of which is to scale up biogenic emissions to regional levels and to evaluate their ozone forming potential, EI structured its work at three levels: the parameterisation of vegetation emissions, the GIS-based scaling of experimental data, the chemical modelling of the ozone forming potential of biogenic emissions.

The IGAC's Aerosol Characterisation Experiment (ACE-2) project, a major data acquisition campaign by land stations, ships and aeroplanes, is due to take place in 1997.

EI plays an international co-ordinating role in both the BEMA and ACE-2 projects.

The novel aspects of the emission process at the leaf and canopy levels identified during the 1993-96 campaigns in Italy, France and Spain were: the variability of biogenic emissions (diurnal, seasonal, intra-species, inter-species) and the resulting limitations on algorithms now used for scaling-up; the reactivity of emitted compounds, related sampling problems, and the determination of emission fluxes.

European Auto-Oil Study

The first European Auto-Oil study was completed in 1996 within the framework of a co-operative programme between the European Commission (DG III, DG XI), the European automobile and oil industries, and the Environment Institute. It was designed to identify the best measures to introduce from the year 2000 on, and to determine the most cost-effective means of reaching air-quality objectives in the year 2010. Different predictive models, based on existing air quality objectives and on the new World Health Organisation air quality guidelines for Europe, were used for estimating emission reductions for urban pollutants in seven representative cities (Athens, Cologne, The Hague, London, Lyons, Madrid and Milan). Emissions are expected to decline significantly as a result of measures already agreed in all seven cities. Benzene and carbon monoxide concentrations will probably be below target values. For nitrogen dioxide, however, the more stringent target value may still be exceeded. For ozone, a regional model was used for assessing the impact of potential policies on concentrations across Europe. National emissions of ozone precursors are predicted to be reduced by 35 to 40 per cent over the period 1990 to 2010.

For aquatic systems, the institute was particularly active in the study of the "red tides" in the Mediterranean sea (MITO–Microphyte Toxins project) and in a vari-

ety of water management, water quality and recovery projects such as AMAL–Advanced Mobile Analytical Laboratory, AQUACON–Analytical Quality Control and SALMON–Satellite Remote Sensing for Lake Monitoring.

Within the Life Sciences and Technologies programme, research was carried out on trace metals in human tissues (TERVIHT–Trace-Element Reference Values in Human Tissues, TRACY–a database on toxic metals in human tissues and fluids, and METOX–Metal Toxicity in humans, projects).

Institutional Support Activities

The Environment Institute was involved in requests from DG XI (Environment, Nuclear Safety and Civil Protection), for the preparation and implementation of directives on atmospheric pollution, from DG III (Industry), DG VI (Agriculture), DG XXI (Customs and Indirect Taxation), and DG XXIV (Consumer Policy). These activities concerned food and drug/consumer protection, control of fraud, and the harmonisation of chemical and microbiological analytical methods concerning food, animal feed, cosmetics, and chemicals.

The European Office for Wine, Alcohol and Spirit Drinks (BEVABS) and a telematics and informatics centre devoted to medicinal products–ETOMEP (European Technical Office for Medicinal Products) were especially active in support activities for the European Agency for the Evaluation of Medicinal Products (EMEA).

EI carried out work on Radioactivity Environmental Monitoring (REM), established after the Chernobyl accident. REM, ERLAP (European Reference Laboratory for Air Pollution) and the radioactivity release early warning system ECURIE (European Community Urgent Radiological Information Exchange) operate in support of DG XI. ERLAP organised, in October 1996, a workshop on Quality Assurance and Accreditation in the field of air quality, with the participation of air pollution laboratories in the Member States.

The principles and the basic rules of functioning of the Alpine observatory were approved by the Conference of the Ministers of the Environment for the Alpine Convention. The JRC is the coordination body for the Alpine observatory. In 1996, EI was involved in a series of pilot projects, such as an information system on alpine research, and the production of a set of socio-demographic indicators.

In the field of institutional support to EC policies, the largest effort concerns chemicals, for DG XI. The European Chemicals Bureau (ECB) has five working groups which tackle different aspects of quality control, risk assessment, and testing methods, in order to implement EC directives on dangerous substances, import export, and existing chemicals.

An important activity in the field of life sciences is that of the European Centre for the Validation of Alternative Test Methods (ECVAM), which aims to replace or reduce the use of animals in laboratory studies. The Centre also promotes a dialogue between legislators, industries, biomedical scientists, consumer organisations, and animal welfare groups, for the development, validation and international recognition of alternative test methods. A large exercise of validation was started in 1996 on alternative methods for testing skin corrosivity; it should be completed by mid 1997.

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions and Other Competitive Activities

The Food and Drug/Consumer protection unit was active in the following shared-cost actions:

- Use of isotopic techniques for food analysis (network within the Measurements and Testing programme).
- Reference materials for authenticity proof of food and beverages.
- Biomarker analysis (FAIR programme of DG XII).
- Validation of analytical methods of determining the content of aflatoxins, ochratoxin and patulin in foodstuffs of vegetable origin.
- Development and intercomparison of improved methods for the determination of fat soluble vitamins in food by replacing hazardous organic solvents with supercritically cold carbon dioxide.

Competitive support to DG III (Industry), on the evaluation of analytical methods used to assess compliance with foodstuffs legislation on chocolate, honey, infant formulae, and intense sweeteners, and to DG XXI, for the detection of other cereals in glucose derived from maize, was also provided.

Other Shared-Cost Actions awarded in 1996 within the Environment and Climate Programme were:

- The SALMON Project (Satellite Remote Sensing for Lake Monitoring).

- The EROS 21 Project on the interactions between the Danube, Dnestr and Dnjepr rivers and the north-western Black Sea.

- The OMEX Project, an integrated study of the physics, chemistry and biology of the continental shelf, and the Cuu Long project on the Mekong delta.

- The FAME action (Fate and activity modelling of environmental pollutants using structure-activity relationships).

Other important income sources were competitive EI participation in EC structural funds projects, and the competitive support to EMEA and the pharmaceutical industry. In the field of consumer protection, the EI provided competitive support in the field of food and drug analysis.

The EI also carried out research work under contract for the pharmaceutical industry and regional authorities. An important contract was signed with the Italian Ministry of Agriculture on forest degradation.



BEMA Project: study of biogenic emissions from a Mediterranean oak using a Teflon® cuvette in the environmental chamber (phytotron)

THE SPACE APPLICATIONS INSTITUTE

The Space Applications Institute (SAI) is devoted to research and applications development using space systems. Formerly called the Institute for Remote Sensing Applications, SAI has expanded its applications base beyond earth observation to include satellite telecommunications and navigation systems in a synergy with remote sensing systems.

Applications development has continued to focus on the framework programme line Environment and Climate, with actions such as the Centre for Earth Observation (CEO), natural resource monitoring, and advanced techniques for earth observation.

The Institute continued to provide customer DG with important scientific support for the collection of agricultural statistics, and expanded these activities to neighbouring countries in Eastern Europe where environmental impacts were also closely examined.

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

The exploitation of earth observation data for the mapping of land cover and land degradation in Europe and in the world remained one of SAI's important R&D fields.

SAI continued to provide support for the Centre for Earth Observation (CEO), the overall objectives of which are to develop operational uses of earth observation data from space in support of customers and to stimulate EO service providers to provide customers with data and information derived from the data to meet their needs. Considerable effort has also been invested in several pilot projects such as agricultural production, European forestry, monitoring of European coastal zones, and creation of an atlas of major European urban areas, demonstrating the potential operational use of information derived from EO data.

Other CEO initiatives focused on education and training, and on the determination of potential customers' information requirements in areas such as tourism, civil engineering, insurance, local government, and environmental protection.

The European Goniometer was used to study the angular reflectance of vegetation: several hypotheses were tested, especially in a series of experiments simulating conditions typical of sub-arctic landscapes. This will support the development of a new algorithm and new applications. The Geophysical Processor has been further improved. Key applications are the measurement of forest heights, an improved discrimination of land use areas and the monitoring of landslide areas.

Applications based on data from new ocean colour sensors are now being developed at the institute. To promote the use of new sensors, a European initiative has been developed for European waters, and work on sensor calibration and validation continues, in full collaboration with international and national space agencies.

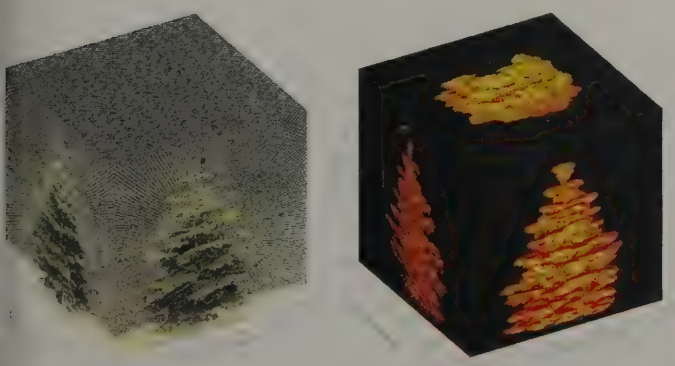
Significant progress was made in the analysis of soil degradation in the Mediterranean region through advanced spectral analysis. Mapping was also a theme for the FIRS (Forest Information from Remote Sensing) project: a new initiative, where advanced methods for data and image analysis were applied to the study of urban areas. Portable satellite data receiving stations were used in Central Africa as a contribution to atmospheric research programmes on global change. A first wall-to-wall high resolution map was established, thanks to the European Remote Sensing Satellite ERS-1, for the entire central African tropical forest, where perpetual cloud cover makes mapping from optical satellite data nearly impossible. Work within the Environment and Climate research programme also dealt with forest fires, both in terms of global change and in the context of natural hazards.

An overriding interest in the quality of human life–which drives the SAI's involvement in hazards study–was also a major factor behind successful new work on the remote detection of antipersonnel land mines.

A European R&D programme was prepared in support of the development of information and data fusion systems for humanitarian de-mining.

Three-dimensional Aperture Radar Image of a Spruce Tree

A new method of identifying at a distance various species of conifer trees, thanks to detailed 3D radar images, has been developed in 1996 in a joint endeavour of the European Microwave Signature Laboratory (EMSL) at SAI, and the Canadian Centre for Remote Sensing (CCRS).



This involves a huge number of measurements in the EMSL, and complex computer modelling to generate from them a final image. This work will contribute to the Unified European Forest Information System, by giving the scientific community a tool to critically assess forest models.

Industrial applications in the European Microwave Signature Laboratory included work with the European automotive industry. Tests on 3 different realistic road asphalt targets under dry, wet and icy conditions showed considerable promise for the development of on-board "radar" systems for the car of the future.

Institutional Support Activities

The MARS-STAT activity (Monitoring of Agriculture with Remote Sensing) provided support to DG VI (Agriculture), EUROSTAT, and the Member States in the implementation of the regional crop acreage inventory activity, which is now fully operational and has been transferred back to the Member States. Support was also provided to DG VI in the form of rapid estimates of 1996 total crop acreage. MARS-STAT activities now include production forecasts of major EU crops for all Member States, including the last three countries to join the Union. A prototype system for monitoring crop production in Central and Eastern Europe and the Maghreb region was also started. Finally, research focused on the use of synthetic aperture radar imagery for rapid crop production estimates. This method would offer many advantages because of the all-weather capabilities of radar.

The MARS-CAP activity continued the remote sensing control of farmers' area declarations for aid. A cost-efficiency study of these remote sensing controls was carried out, together with a quality control of the work contracted out by national administrations to private companies. Technical support and advice were provided on the implementation and possible improvements of the Integrated Agricultural Control System in the Member States. This activity was carried out in an almost direct interaction with the Member State administrations.

SAI was involved in experiments on the use of Global Positioning System (GPS) for parcel area control. Support on the establishment, the updating and the possible redefinition of the vineyard and olive registers, in association with the new OCM (Organisation Commune du Marché), was provided to the Commission and the Member States.

Support to the European Environment Agency concentrated on developing the work of the Land Cover Topic Centre, in collaboration with various European organisations.

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions

The Space Applications Institute submitted 19 proposals in a range of thematic areas including Agriculture, Telematics, and Environment and Climate, and enjoyed an extremely high rate of success, with 10 of the projects being funded. 8 out of these 10 focus on the marine environment. Projects cover fish resources, biological processes, pollution and coastal zone studies, and the geographical foci range from the Canaries to the Mediterranean, Baltic and Black Seas.

Competitive Support for Community Policies

SAI responded to open calls for tender from DGs. Of these, DG XIII (Telecommunications, Information Market and Exploitation of Research) awarded a contract for the dissemination of data to the European research community from SAI's European Microwave Signature Laboratory. DG XI (Environment, Nuclear Safety and Civil Protection) awarded a contract for the second phase of the operational tropical forest monitoring project started in 1995. This work will, on completion, provide an earth observation based system for tropical forest mapping, for the management of diverse tropical forest data sets and for the provision of an "alarm" system, pointing out areas of extreme deforestation.

Research under Contract

Nine contracts were carried out in 1996 for industrial, governmental and research organisations. These were all small pilot projects, related directly to the Institute's research programme. Examples include the use of EMSL by the automotive industry, and an extension of the remote sensing monitoring of agriculture project into non-European countries.

Other Competitive Activities

The MERA project (MARS and Environmental Related Applications) covering the 12 PHARE countries, entirely funded by DG IA (External Affairs), went into full operation. The techniques developed for remote sensing agricultural production monitoring in the EU were transferred to neighbouring East European countries. There was also a strong emphasis on forest resource management and environmental impact assessment in these countries. The SAI's technical management role also included projects on the use of remote sensing for monitoring rice production in Indonesia and for coastal zone management in Thailand. In both cases, SAI provided DG IB with specific technical know-how which directly supports the customer DG's technical programme.

THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES

The Institute for Prospective Technological Studies was created to observe all relevant, significant and outstanding scientific and technological events and trends in Europe, and to follow technological change in order to get a better understanding of the links between technology, the economy and society. Its activities contributed to the Framework Programme line Targeted Socio-Economic Research.

The Institute moved from Ispra to Seville in 1994; an operational work programme was agreed in 1995 and the Institute was restructured into two operational units:

- Technology Watch (TW): the aim of the TW structure is to detect, at an early stage, scientific breakthroughs, events and trends that might lead to technological innovation, and to alert EU decision makers to their implications and consequences, especially when there is a need for action at a European level. This unit co-ordinates the ESTO network.

- Technology, Employment, Competitiveness (TEC): this unit deals with economic sustainability issues in relation to the business practices of firms (competitiveness focus); economic and social sustainability issues in relation to work/wealth distribution (employment focus); the role of innovation in regional development and management resources (regional focus).

A. INSTITUTIONAL ACTIVITIES

Institutional Research Activities

The European Science and Technology Observatory

The European Science and Technology Observatory (ESTO) is a network of 15 European multidisciplinary organisations, whose main task is to enlarge the knowledge base on which Technology Watch is operating; it has an Executive Commitee, chaired by IPTS, which oversees the animation and management of the network.

The Institute also provides the necessary orientation in the various procedural phases, thus giving a European dimension to the results; assists in the identification of the main trends governing S/T developments and events; and ensures that all findings are subsequently translated into strategic terms and options to be presented in the most appropriate format to European decision makers.

The ESTO's mission is to collect and to process information at the European level to support decision making

and is complemented by specific-in-depth prospective analyses aimed at shedding light on the interface between scientific and technical aspects, on the one hand, and the economy and society, on the other.

The most important projects already accomplished or being undertaken are focused on the following fields:

- Technology Transfer and Advanced Materials.
- Nanotechnology: Innovation potential and societal aspects.
- Human Genome Analysis, Genetic Screening and Gene Therapy.
- Monitoring and Evaluating selected water-related technologies (eg. "Desalination Technology").
- Employment (e.g. "Industrial Clusters, Networks and Districts for Employment").
- Assessment of CO_2- related technologies.

The Institute provided Science and Technology background information to the Euro-Mediterranean Monitoring Committee (proposed by the Council and established in the framework of the Barcelona Conference in November 1995), thus stimulating S/T cooperation in the Mediterranean region.

This work has been undertaken in close contact with the Commission services responsible for the implementation of the relevant R&D programmes (e.g. IMT, JOULE, BIOMED).

In the field of regional development, the Institute produced a comparative study of several regions "The potentials of Science and Technology-Innovation for Regional Development".

Institutional Support Activities

A new agreement between IPTS and the Forward Studies Unit (FSU) of the Commission is now covering a variety of subjects related to the business environment, the definition of sustainability, the problem of accounting, and the global warming debate.

Within the context of the work carried out for DG XVI (Regional Policies and Cohesion), the project "Water Management in the Mediterranean" examined not only the technological point of view, but also the various socio-economic, cultural, environmental and political factors conditioning both the need for water and the appropriateness of particular water management tools in the Mediterranean basin countries.

IPTS supported the European industrial policy under DG III (Industry). The Institute's competence in technology foresight-watch contributed to identifying key technological trends and to analysing the impact on industrial innovation in the following areas:

- Support to IRDAC (Industrial Research and Development Advisory Committee).
- Competitiveness and the organisational practices of firms (e.g. Agile enterprises).
- Systems of innovation and economic webs (e.g. cogeneration technology; Intellectual Property Rights).
- Industrial technologies' forecasting.
- Employment and Technology: being competitive in Europe.

In the context of the preparatory phase for the implementation of the Integrated Pollution Prevention and Control (IPPC) Directive, the institute had carried out the first pilot project on Best Available Techniques (BAT), following the IPPC rules. Winthin the same framework, IPTS made an offer to DG XI (Environment, Nuclear Safety and Civil Protection) to establish a Bureau for European Integrated Pollution Prevention and Control, which will support the implementation of the Council Directive on this issue.

Three prospective studies were developed for the Scientific and Technological Options Assessment (STOA) programme of the European Parliament, covering common fields of interest such as: "Information society: competitivity and employment"; "The future of the car: individual mobility"; and "Trends in the pharmaceutical sector".

Two other studies on Climate Change and Recycling were completed in 1996 for the Environment Committee.

The Institute also organised a hearing for the European Parliament on "Research and Sustainable development" and a seminar on "European research in the perspective of the XXIst Century" with the intention of stimulating a debate on the orientations for the 5th Framework Programme.

B. COMPETITIVE ACTIVITIES

Shared-Cost Actions

The IPTS is at present running 8 shared-cost action projects: 4 concerning the energy sector, 3 concentrating on different environmental issues, and one developed within the framework of regional development.

All four energy projects were approved under the JOULE programme, and are focused on:

- Creation of a focal point of data on external costs of energy.
- Renewable energies from a regional perspective.
- Global Energy, Economy, Policies and CO_2 Emission Pathways (Energy-Economy-Environment quantitative analysis.
- Biomass studies.

Two of the three environmental projects are in the field of sustainability:

- Green accounting: tools for assessing progress towards sustainable development.
- Technology's role in sustainable development.

The third environmental project concerns:

- Analysis and assessment of environmental policy instruments for the implementation of efficient ozone abatement strategies in the European context.



Work under Contract

In the context of the development of the European strategy for waste management, IPTS has organised a review of various options for recycling plastics packaging waste, under a contract issued by the Association of Plastics Manufacturers in Europe (APME).

The Institute has also concluded a project contracted with the Andalusian Energy Agency (SODEAN) on a "Technical-Juridical European Forum on Renewable Energy". The project was devoted to the organisation of a conference on the technical and legal barriers that renewable energies encounter upon their penetration into the energy market.

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Organisation Chart (October 1996)

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7. Indoor pollution	Helmut Knöppel
8. Food and drug analysis; consumer protection	Giorgio Serrini
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Please read the following row of *Table 6*, page 24, as follows:

Visiting scientists, seconded experts, grantholders

Table 6

as of December 1996

Institutes	Visiting Scientists	Seconded Experts	Post-Doc. Scientists	Post-Grad. Scientists	Total
Environment Institute	3	1	8	26	38

15

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